October 11, 1928

# Engineering News-Record

Devoted to Civil Engineering and Construction

Sludge-Return Pumps of World's Largest Activated-Sludge Sewage Disposal Plant at Chicago

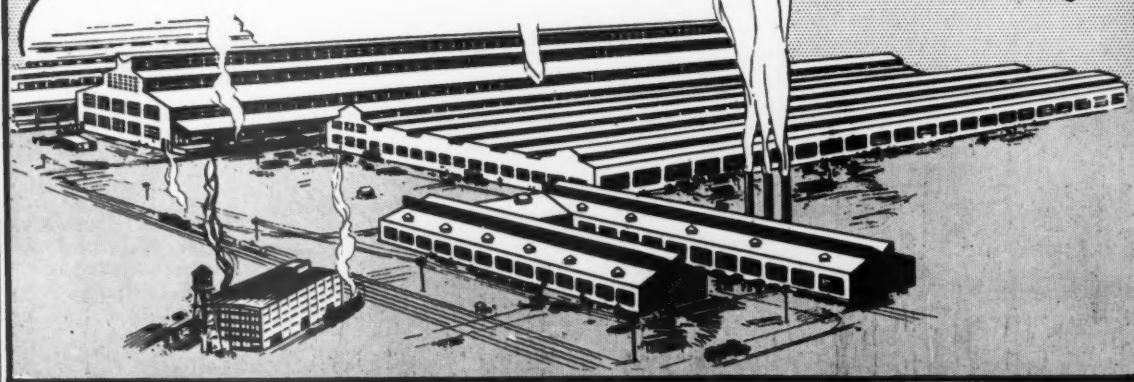
# A Million Square Feet of Roof *and* Half a-Million More

A year ago, General Motors covered this big Oakland-Pontiac plant with a Federal precast concrete roof. A half-million square foot addition has just been completed, and again Federal furnished and erected the roof — *at record speed under extreme winter conditions!*

It is a recognized fact, that practically every make of automobile on the streets today, is built under a Federal roof. The iron and steel industry too, has long since accepted Federal as standard.

*Made, Laid and Guaranteed by*
FEDERAL CEMENT TILE CO.
608 S. Dearborn Street · Chicago
*For over a quarter century*

*No Building Can Be Fire-safe Without a Fireproof Roof*



FEDERAL CEMENT TILE

New York, October 11, 1928

# Engineering News-Record

*A Consolidation of Engineering News, Engineering Record, The Sanitary Engineer, and The Contractor*

F. E. SCHMITT, *Editor*

*Editorial Staff*
*New York*
M. N. BAKER
C. S. HILL
W. G. BOWMAN
H. W. RICHARDSON
V. T. BOUGHTON, *Managing Editor*

WILLARD CHEVALIER
*General Manager*
*Editorial Staff*
*Chicago*
E. E. R. TRATMAN
W. W. DE BERARD
*San Francisco*
N. A. BOWERS

## Contents

*Volume 101, Number 15, October 11, 1928*

**Traffic Engineering in San Francisco** ..... 536
PEDESTRIAN control and loading zone installations are remedies to restrict congestion in the city's streets.

**Formulas for Steel I-Sections in Torsion** ..... 541
RESULTS of a series of tests made at the school of engineering, Northwestern University. By William B. Campbell

**Largest Activated-Sludge Plant in the World** ..... 543
CHICAGO SANITARY District opens works to treat 175 m.g.d. of sewage from 830,000 people.

**Replacing Pavement on Removal of Car Tracks** ..... 545
TIES LEFT IN PLACE when utility removed rails and restored pavement for return of streets to city.

**Bascule Bridge Erected Over Railroad Tracks** ..... 546
WORK of building 204-ft. bridge over site of new channel of Chicago River carried on under traffic.

**Efficiency of Overlap Welds in Penstock Pipe** ..... 550
AVERAGE of many tests shows welds of over 90 per cent of plate strength for thicknesses of 0.4 to 1.3 in. By Oren Reed

**Filter and Pump Layout for Jackson Water-Works** ..... 552
FEATURES of the plant are compactness, duplication, flexibility, reliability and complete operating control. By J. H. Ferrell

**Civil Engineers Study Irrigation and High Dams** ..... 553
TWO MAJOR PROBLEMS of West are outstanding topics at San Diego meeting of Am.Soc.C.E.

**Progress on the Cascade Tunnel** ..... 555
MAIN TUNNEL completed to full section for 7 miles and concrete lining placed for 6 miles.

**Editorials** ..... 533
**From Job and Office** ..... 556
**Letters to the Editor** ..... 560
**News of the Week** ..... 562
**Construction Equipment and Materials** ..... 568
**Business Side of Construction** ..... 570

## *Index 1923—1927*

THE FIVE-YEAR INDEX of *Engineering News-Record* has been completed and will be published on Nov. 1.

THE publication date has been delayed beyond that originally announced in order to make the index more complete.

DISTRIBUTION of copies already ordered will begin as soon as the books are off the press. Those who have not ordered may still obtain copies by sending their order to the Editor, *Engineering News-Record*. The price of the index is $4.

**McGRAW-HILL PUBLISHING COMPANY, INC., TENTH AVENUE AT 36TH STREET, NEW YORK, N. Y.**

NEW YORK District Office, 285 Madison Avenue
WASHINGTON, National Press Building
CHICAGO, 7 South Dearborn Street
PHILADELPHIA, 1600 Arch Street
CLEVELAND, Guardian Building
ST. LOUIS, Bell Telephone Building
SAN FRANCISCO, 883 Mission Street
LONDON, 6 Bouverie Street, London, E. C. 4

JAMES H. MCGRAW, President
JAMES H. MCGRAW, JR., Vice-President and Treasurer
MALCOLM MUIR, Vice-President
EDWARD J. MEHREN, Vice-President
MASON BRITTON, Vice-President
EDGAR KOBAK, Vice-President
C. H. THOMPSON, Secretary

Publishers of
American Machinist — Engineering News-Record
Power — Chemical and Metallurgical Engineering
Coal Age — Food Industries — Radio Retailing
Engineering and Mining Journal
Ingeniería Internacional — Electric Railway Journal
Bus Transportation — Electrical Merchandising
Electrical World — Construction Methods
Electrical West
(*Published in San Francisco*)
American Machinist—European Edition
(*Published in London*)

SUBSCRIPTION PRICES: United States and its possessions, Canada, Mexico, and other countries taking domestic postage rates, $5 a year. All other foreign countries, $9 a year. Single copy, 25 cents. Published weekly. Entered as second class matter, April 11, 1917, at the Post Office, New York, N. Y., under the act of March 3, 1879. Printed in U. S. A.

Copyright, 1928, by
McGraw-Hill Publishing Company, Inc.

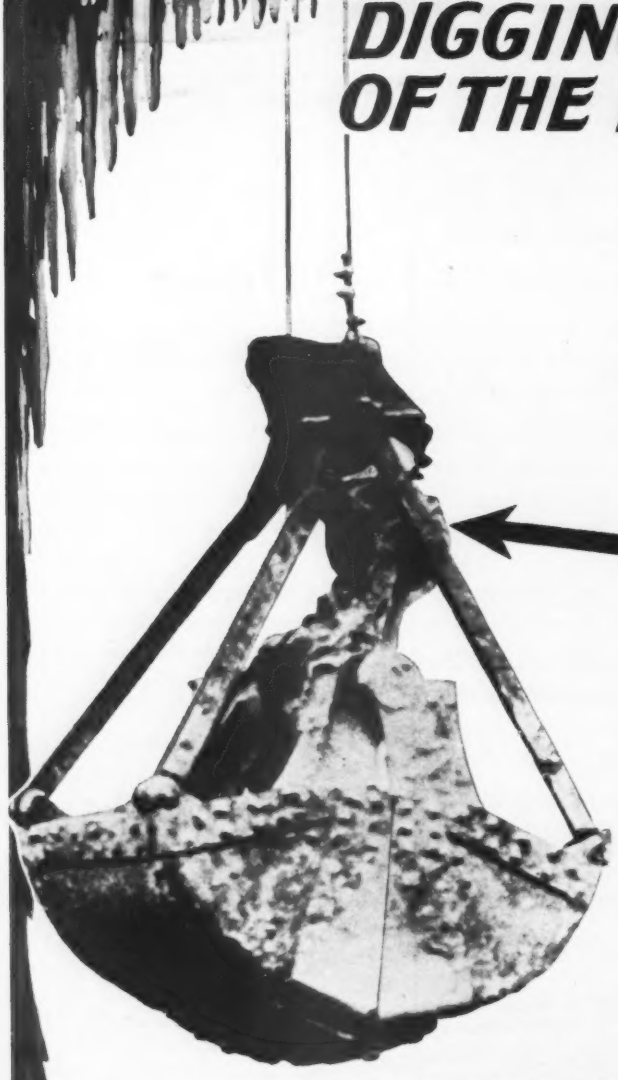
CHANGE OF ADDRESS

Subscribers are requested to send both the old address and the new address when they move to a new address.
Member—Audit Bureau of Circulations.
Member—Associated Business Papers.

**Construction Market Place, 166** **Searchlight Section, 140** **Index to Advertisers, 174** **Directory of Consulting Engineers, 136**

**Number of Copies Printed This Issue, 31,827**

# 18" OF FROST PROVE THE DIGGING EFFICIENCY OF THE DREADNAUGHT



It's tough digging when you have 18 inches of frost in the ground—"no foolin'." That's the time for a Blaw-Knox ***Dreadnaught Bucket.***

Henry Ericsson Company of Chicago, say: "While we were using the Blaw-Knox ***Dreadnaught Bucket,*** we had at times over 18 inches of frost which we were breaking with the bucket, using no ball or any other means of breaking the frost. We are pleased with the performance and have had no expense for repairs."

## BALL BEARING SHEAVES

This new feature, exclusive with Blaw-Knox, adds immeasurably to the life of the bucket, increasing digging power and reducing friction losses to the minimum. Grease is sealed in. Sand and grit are locked out.

Bulletin 1017 contains complete engineering data with illustrations. *Write for your copy now.*

**BLAW-KNOX COMPANY**

601 FARMERS BANK BUILDING PITTSBURGH, PA.

NEW YORK DETROIT BUFFALO CHICAGO PHILADELPHIA
BALTIMORE BIRMINGHAM CLEVELAND

EXPORT DIVISION: Milliken Bros.—Blaw Knox Corp., Canadian Pacific Bldg., New York City

**BLAW-KNOX**

# ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

McGraw-Hill Publishing Co., Inc.
JAMES H. McGRAW, *President*
EDWARD J. MEHREN, *Vice-President*

WILLARD CHEVALIER
*General Manager*
F. E. SCHMITT
*Editor*

Volume 101 | NEW YORK, OCTOBER 11, 1928 | Number 15

## *Engineering Progress*

WITH many high dams under construction and ever greater heights contemplated, the formulation of a comprehensive statement of the science and art has come to assume critical importance. The last decade saw much advance in theory and valuable accumulation of experience, but as yet neither has been co-ordinated with the many surviving conceptions of earlier date to form a balanced and well-grounded science. In short, the art has developed into an incongruous composite. This is not adequate to modern demands, which call for assurance of safety. In the West, where many high dams are being built, rapidly extending settlement makes it inevitable that large areas of human habitation will be located in their shadow. Naturally, then, popular attitude and apprehensions of safety have become an important factor in the planning and financing of storage projects. Therefore consideration of the subject at the San Diego meeting of the American Society of Civil Engineers was of utmost timeliness and formed a brilliant feature of the meeting. Less progress was made than might have been achieved. With many challenging questions standing forth, a vigorous crossfire of discussion and pooling of experience and judgment would have notably furthered a constructive result. But this gathering of leading dam builders remained silent for the most part, displaying the traditional reluctance of engineers to speak out in meeting. An opportunity was lost. The pace of today's progress is impatient with the delays of correspondence discussions. As the problem remains most urgent, it may be hoped that all possible will be done to focus the best thought upon it speedily. An adequate foundation for the future engineering of dams is at issue.

## *Public Service*

AS IN DAMS, so also in reclamation policy. The society entered on a most important undertaking. In almost half the area of our country human existence and progress are closely interwoven with irrigation. Future irrigation growth, however, has become so involved in seemingly hopeless difficulties that further progress is hardly possible without the leadership or at least close co-operation of engineers. True, the root troubles are economic, but they are such that only the information and reasoning of engineers can discover the right path. Hitherto engineers as a professional body have seemed to shrink from the problem, perhaps because of its politics and violent partisanship. In now taking up the problem seriously the irrigation division of the American Society of Civil Engineers has made a courageous beginning. Its committee report, reached only after sharp differences of view had been adjusted, deals forcibly and wisely with certain of the basic factors. Thus the pronouncement against the no-interest feature of federal reclamation policy and the advocacy of government stream regulation will help greatly in building up sound thought. Some few clauses remain open to question and the report is far from complete. Much remains to be done before it will constitute a comprehensive and constructive statement of national policy. By continuing its labors the division will do a service to the community.

## *Safety Encouragement*

INSPIRATION and encouragement are bound to come from a convention of 6,000 delegates, all interested in one idea—that of promoting safety. The construction section of the National Safety Congress, a small part of the convention held in New York last week, pledged itself to carry on the safety work started within its ranks. No direct action was taken or can it be said that any direct benefit resulted from the meetings. However, the great good coming from the convention was the mingling of the delegates, all with a single purpose, exchanging ideas and receiving inspiration from the success of others engaged in safety work. The construction industry has been slow in getting started in the safety movement. Delegates returning from the New York convention will undoubtedly inject a new spirit into the work of making a normally hazardous industry as safe as possible for its workers.

## *A Large Contract*

SINGLE contracts for construction operations costing tens and scores of millions are no longer uncommon. At the highest measure of cost which has been reached, however, there have been few if any construction operations which possess greater claim for the record in money value of straight construction contract agreements than the contract made last week with the city of New York to build a water tunnel from the mainland in the Bronx under the East River to Astoria on Long Island and thence to Brooklyn. As stated in our news columns, the bid of Patrick McGovern, Inc., of New York, of $42,692,568 for the entire tunnel has been accepted. Bidding separately on each of the four sections of the tunnel, the same contractor's bids aggregated $44,511,000. The total of the low bids of all bidders on the four sections was $43,394,000. The contract therefore was let at the lowest price asked for building the whole tunnel. These facts deserve to be noted in connection with the decision of the Board of Water Supply to award one contract for the whole tunnel instead of a separate contract for each of four parts of the tunnel. It is, however, the amount of the contract in dollars that chiefly focuses attention. There is always a risk in naming as largest anything in engineering, but this New York tunnel is offered as the largest work in the United States ever awarded undivided on a straight public works contract basis with a definite time limit for completion. Excepting the contract for the Conowingo hydro-electric plant let to Stone & Webster for $52,000,000, it is the

largest contract ever let undivided for either industrial or public works. The great Rayon plant at Happy Valley, Tenn., was let to two contractors for $37,500,000. Next to the McGovern contract the largest single contract for public works of which we find record is the subway contract awarded to Mason Hanger in 1927 for $22,272,309. Forgetting comparisons, these values of single contracts undertaken by our large construction organizations in the regular line of today's business indicate a growth in contracting which remains impressive even in the light of the enormous totals of individual contracts for cantonments and shipyards during the World War.

### *A Problem for Local Organizations*

HOLDING that finding the remedy for bettering the financial return to the engineer is a problem of the local and not of national engineering societies, Michigan engineers are calling together for conferences and action representatives of a number of local societies. The idea was first propounded by Alex Dow, president of the American Society of Mechanical Engineers, in an address last spring to a joint session of the Detroit Engineering Society and the local section of the Am.Soc.M.E. Local, said Mr. Dow, are all of the budget-making agencies; local are all the factors that have influence on these agencies; and locally must the pressure be exerted to make administrative bodies see the necessity of paying adequate salaries to command competent service. The national societies are too far removed from the scene to have any influence on local problems. Only the officials of the national societies can take part in any action that is deemed worth while, so that at best the full force of the prestige of the national society comes second hand. Once the problems of salary increases and ratings is recognized as of local import, there only remains the task of organizing, financing and operating a local agency to analyze the local situation and effect such action as each case needs. That is the problem to be put before the conference of Michigan local societies. Several years ago when the American Association of Engineers was in the formative stage this idea was brought forth, but the local technical organizations were not receptive and the A.A.E. went ahead on the basis of a national organization made up of local groups organized primarily for welfare work. Whether the present-day officials of local technical organizations will answer the call with any more enthusiasm than did their predecessors remains to be seen. The A.A.E. local organizations, once quite numerous, have dwindled to a comparatively small number. The field for the local technical organization is wide open. The national societies, by the very nature of things, as Mr. Dow so well pointed out, cannot function. The problem is up to the local organizations, where it belongs. Will they accept the challenge?

## *Better Time-Payment Selling*

IN NAMING a down payment of 25 per cent and a limit of from two to four months for deferred payments on all construction equipment except heavy excavators, rollers, tractors and crushers, for which the limit is extended to nine months, the Associated General Contractors has set up a definite mark at which to aim in standardizing time-payment credit practices. Further action now lies in securing agreement to these terms by individual manufacturers. Some of these have already announced their purpose to put the new credit schedule or its equivalent immediately into force. These progressives are comparatively few. A far larger number express commendation of tighter credit terms and indeed approve terms which are even harder on the buyer, but they are not ready to inaugurate a change in practice unless their competitors will also fall in line. And finally a recalcitrant few will have nothing to do with the A.G.C. plan or any plan that limits their freedom to dicker with credit terms as the conditions of a sale may determine it to be desirable.

It is far from a hopeless situation, then, which has been reached after nine months of labor in straightening out the jumbled practices of time payments in the construction equipment field. There had to be much missionary work among both the equipment manufacturers and their distributors. The contractors themselves were far from convinced at the start that they had anything to gain by restricting their privilege to make the best trade individually that they could. All of them even in the A.G.C. ranks are not yet ready to forego their freedom in buying credit. The manufacturers and distributors had to be taught that credit practices had fallen into an evil condition which was undermining the industry and also that contractors in seeking the correction of this condition were honestly trying to cure a general evil and not to reap an individual benefit. The year's work of the Associated General Contractors has not only set up a high mark in credit terms at which to shoot but has gathered a large element of the equipment merchandising business at the butts to try their marksmanship.

Under the conditions this is accomplishing a great deal. There are, as the better-credits campaign approaches its second year, strong hopes that an additional twelve months will witness a real reform in time payments for construction equipment. Not the least of the influences which have encouraged this progress, it is only fair to note, is the fact that organized contracting is voluntarily asking not easier credit terms but terms which bear much harder on the buyer and give the seller his money much sooner.

## *Penalizing Intelligent Specifying*

A SNARL over the award of a contract for water pipe at Dallas, Tex., presents a novel feature due to fire insurance rates peculiar to Texas and teaches some lessons in drawing proposals for contracts. From details given elsewhere in this issue, it appears that the call for proposals was so worded as to make it difficult to compare the bids for the different materials offered, due in part to permitting bids on materials only, laying only, or a combination of these.

After the controversy over choice between cast-iron and steel pipe was begun it was made worse by the announcement of a fact that seems to have been overlooked, a 5c. per $100 fire insurance rate penalty in any Texas city where other than standard cast-iron pipe is used in a "distribution system," these words being interpreted to include pipe from the source of supply to what is generally understood to be a distribution system. The local confusion over the situation was increased by the enterprise of a local daily newspaper, which wired to the engineers or superintendents of 25 cities, asking their opinions on the use of electrically welded steel pipe in a distribution system under 200 to 300 ft. head. Some were wise enough not to telegraph their way into a controversy, but of those who replied presumably some answered quite

differently than they would have done had they known that much, at least, of the pipe was to be used as force or trunk rather than distributing mains, as the term is commonly used.

The fire insurance penalty already mentioned is peculiar to Texas—perhaps because fire insurance rates there are established by the state, instead of by the fire underwriters, none of whom appear ever to have penalized steel pipe in the way indicated. As was well pointed out by the consulting engineers for Dallas, the penalty against other than cast-iron pipe is applicable from the date it is put in use, thus eliminating all question as to relative life. The extensive use of steel for supply mains from source to city and for trunk mains with no or but few service connections points to the folly of the Texas penalty. Texas, the Southwest and the Far West have greater need than the rest of the country to bring other materials for water pipe into competition with cast iron, in view of the very heavy freight rates to those regions. All the more reason, therefore, why the unwarranted insurance penalty mentioned should be removed.

## New Trends

IT HAS been evident for some time that strong movements of evolution are going on within technical societies. Tendencies toward growing complexity and toward that form of superorganization which transforms a meeting into a many-headed congress are among recent symptoms of change. Such movements invite reflection as to their broader implications. In the same light recent developments within the American Society of Civil Engineers provoke thought. These latter developments represent strongly marked trends in opposite directions—on the one hand toward specialization, on the other toward centralization.

Changes initiated by the board of direction at the San Diego meeting are directed toward technical specialization. By discontinuing the monthly meetings of the society, by improvement in the functioning of the technical divisions, which already control most of the quarterly meeting activities, and by drawing the zone and local organizations into the work of framing programs, a large part of the society's technical work is turned over to these subsidiary bodies. Little remains of the original system of organization and activity of the society. The grouping of many independent branches of civil engineering in one forum long ago became burdensome as the specialization of the branches advanced. Realignment of work began some time ago by the creation of technical divisions and local sections. The present changes carry this development forward and make it more effective.

In contrast there is a trend toward centralization of non-technical or professional activities in the proposal that the society join the American Engineering Council. This step will form a single body to represent the engineering profession before the community. Bitter discussion waged over this proposal some years ago, but the council organization and procedure have been quite fundamentally reconstructed and it is therefore again put before the membership for vote. It may be assumed that this general organization will deal only with professional matters, avoiding technical pronouncements, since otherwise confusion might result. Thus the proposal of the present referendum is one to centralize professional activities at the same time that the other changes are decentralizing the technical activities of the society.

These movements imply profound and lasting change of our profession's plan of organization. On present outlook they will have a deep influence on the future of the society's life. Reflection on their broader relation to the needs and growth of the profession is therefore as much the duty as the privilege of the individual member. The present time is making history.

## Reward for Public Service

HIGHER salaries in private than in public service are a constant drain upon the personnel of our municipal, state and federal governments. The men who go are those who can least be spared. Proven ability in the public service creates a demand from private quarters with offers of pay that the city or state cannot meet and that to refuse would be suicidal. A notable current example is the resignation of Dr. Louis I. Harris, health commissioner of New York City, to become consultant for a large dairy company. After years of able service in the New York health department, during which Dr. Harris rose to the position of chief of the bureau of communicable diseases, then to the headship of the department, he was drawing $10,000 a year from the municipal treasury—not a princely sum for an official responsible for the health of six million people. It is stated that with the larger salary will come an "increased field of usefulness," but the headship of the largest municipal health department in the world presents opportunities for life conservation unequaled by the largest of dairy companies. More pay, surer tenure of office and greater freedom from political pressure are the motives that cause most men of ability and achievement to leave public for private service.

If the two latter could be assured, fewer than is now the case would be lured into private service for higher pay, although this incentive will never be eliminated, nor is its complete elimination wholly desirable. The real cause for anxiety is lack of public knowledge of what constitutes efficient public service, coupled with an ever-present army of men and women ready and eager to step into any vacancy at any salary that may be offered.

How to get the body politic to appreciate the importance of honesty and efficiency in the public service is the problem. This solved, security of tenure of office and adequate, or at least more adequate, pay for services rendered would follow. Conditions in this respect show improvement but not what must have been expected by those who for years past have been working to that end. Long ago it was declared that a little leaven leaveneth the whole lump. Either the leaven thus far used has been too little, too impotent, insufficiently long at work, or not sufficiently kneaded into the mass of the body politic. More likely, the fact is that reform, like righteousness, must come from within. On the whole, the people of any city or state or country have about the sort of government they deserve. No stream can rise higher than its source except by pumping and then when resort to that is had it soon falls back to its natural level.

It is fortunate that when a man in some field of government activity rises high above his fellows, and far above public appreciation, there is now and then some private activity that recognizes his worth and takes him out of the public service before the turn of politics leaves him stranded. This and the satisfaction of having rendered good service against odds and at low pay are about all the stimulus to do their best that can be expected by public servants in many cities of America.

# Traffic Engineering in San Francisco

## Factors Making for Congestion Recited—Pedestrian Control and Loading Zone Installations Are Remedies Used—Duties of Traffic Engineer

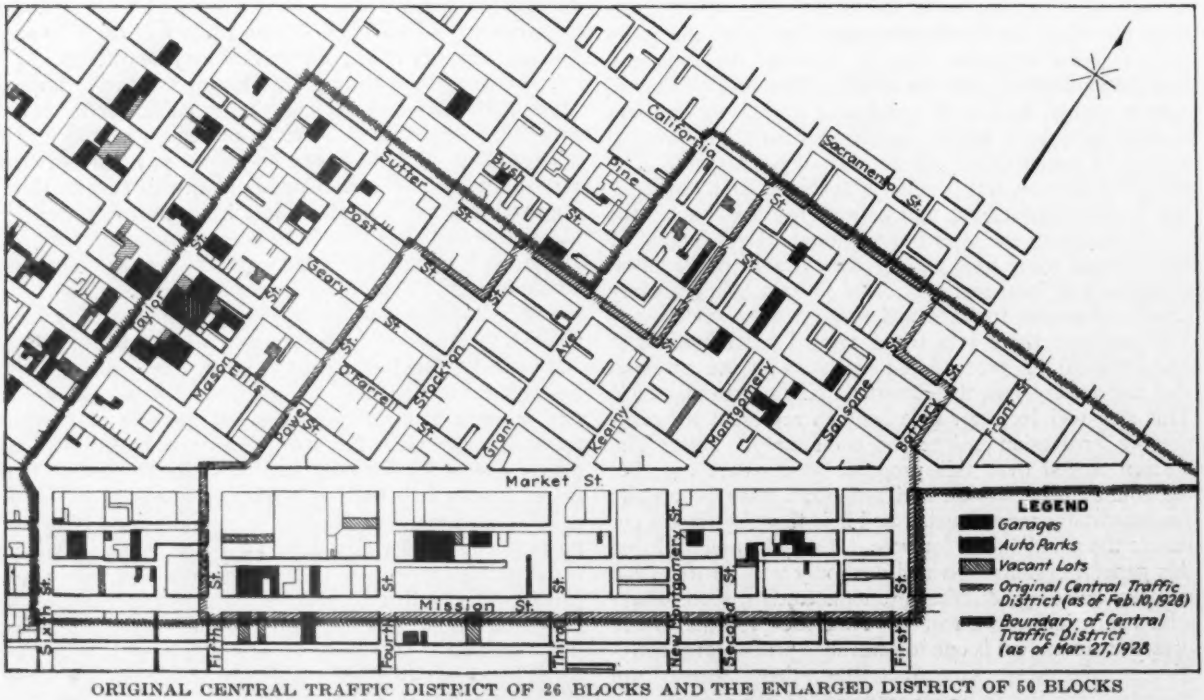
TRAFFIC SURVEYS and accompanying reports have been made in a large number of cities. Slowly results are beginning to be obtained. In nearly every case the recommendations call for the setting up of a department with a traffic engineer in charge to continue the studies already made, to work out solutions for the more difficult intersections and generally to operate the various devices installed, to maintain and if possible to increase their efficiency. Increased registrations add increased burdens on the street floor area, so that without increased efficiency congestion becomes even more serious. New construction eventually becomes imperative, but the operator's job is to make the best of existing conditions. That is the burden of this article. —EDITOR.

LAST year an exhaustive investigation, followed by recommendations, was made of the traffic situation in San Francisco by Dr. Miller McClintock for the San Francisco Traffic Survey Committee. A new code was then adopted. Fewer accidents and increased traffic facility have resulted, as noted in *Engineering News-Record*, May 10, p. 749.

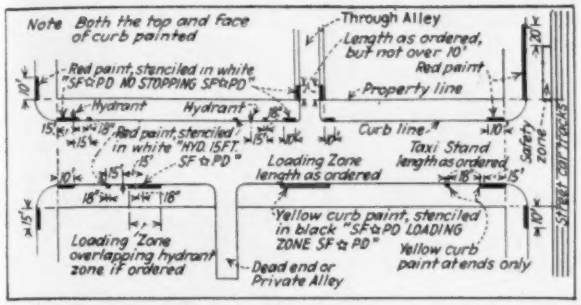
One of the major recommendations of the committee called for the establishment of the office of a city traffic engineer as a means of applying engineering principles in the future solution of the changing phases of the traffic problem. A brief statement of traffic operation factors as disclosed by the survey will indicate the technical character of the problem and the need for setting up the new office. What George D. Burr, who has been on the job as traffic engineer for several months, is planning and accomplishing is outlined herein.

In the first place, the irregular layout of the street pattern in the central traffic district makes handling of traffic by modern signals, signs and regulations as difficult a problem as is found anywhere in the country. At the time for which all figures used herein are quoted—namely, Feb. 10—the central traffic district consisted of 26 square blocks. On March 27 it was increased to include 50 square blocks (see map). Market St., which is the main thoroughfare of the downtown signaled area, runs diagonally through the usual rectangular platting on the north side. From the Embarcadero to Van Ness Ave. a series of seventeen irregularly shaped intersections, all of which differ from one another, result. In the enlarged district the number of irregular intersections is nearly twice as great. The situation is aggravated by the fact that the short block lengths on the north side differ greatly from the extremely long block lengths on the south side. The street direction of the north side is not parallel with that of the south side, hence both acute and obtuse angles exist at the line of Market St. intersections. As a result of this variation traffic can cross Market St. directly in only a few places, and in consequence these few are heavily loaded while adjacent streets remain quite free from travel for the first block contiguous to Market St. This extremely troublesome pattern of traffic movement requires the utmost flexibility of traffic signals, timing and visability.

Because of the irregularity and the fact that Market St. carries four lines of street cars, vehicular traffic shuns the street, although it is 120 ft. wide. Van Ness Ave. carries the most traffic of any street in the city; Howard




ORIGINAL CENTRAL TRAFFIC DISTRICT OF 26 BLOCKS AND THE ENLARGED DISTRICT OF 50 BLOCKS
Little garage space is available in the heart of business district north of Market St.
Note the large number of irregular intersections on Market St.


Note Both the top and face of curb painted
Through Alley
Length as ordered, but not over 10'
Red paint, stenciled in white "SF☆PD NO STOPPING SF☆PD"
Red paint
Property line
Hydrant
Hydrant
Curb line
Red paint, stenciled in white "HYD. 15FT. SF☆PD"
Loading Zone length as ordered
Taxi Stand length as ordered
Safety zone
Street car tracks
Yellow curb paint, stenciled in black "SF☆PD LOADING ZONE SF☆PD"
Yellow curb paint at ends only
Loading Zone overlapping hydrant zone if ordered
Dead end or Private Alley

PLAN FOR RED AND YELLOW PAINT MARKING ON CURBS

St., paralleling Market St. and two blocks south of it, is second; Mission St., one block south, is third, and Market St. is fourth. Van Ness Ave. is a collecting and distributing thoroughfare, operating as such roughly between residence and business districts. The intersection carrying the largest number of vehicles is Van Ness and Bush, where 20,447 vehicles were checked during a traffic day of eight hours. But Market St. carries more pedestrians than any other street in the central traffic district, Grant Ave., a retail shopping street, being second. At the intersection of Powell, Fifth, Eddy and Market Sts., 109,648 pedestrians passed during a typical eight-hour traffic day.

As to concentration, a cordon count every half-hour for a fourteen-hour period from 6 a.m. to 8 p.m. of all traffic entering and leaving the central traffic district indicated 1,073,963 persons, of whom 744,667 were passengers and the remainder pedestrians. The total number of vehicles was 203,641 on a typical fourteen-hour day. The great inrush is from 7:30 to 9 a.m., with maximum accumulation at 2:30 p.m., when approximately 4,300 vehicles and 88,000 persons are gathered. The control problems are somewhat revealed from the fact that the streets of the district are forced to serve 97,500 persons between 5 and 5:30 p.m., the period of greatest use.

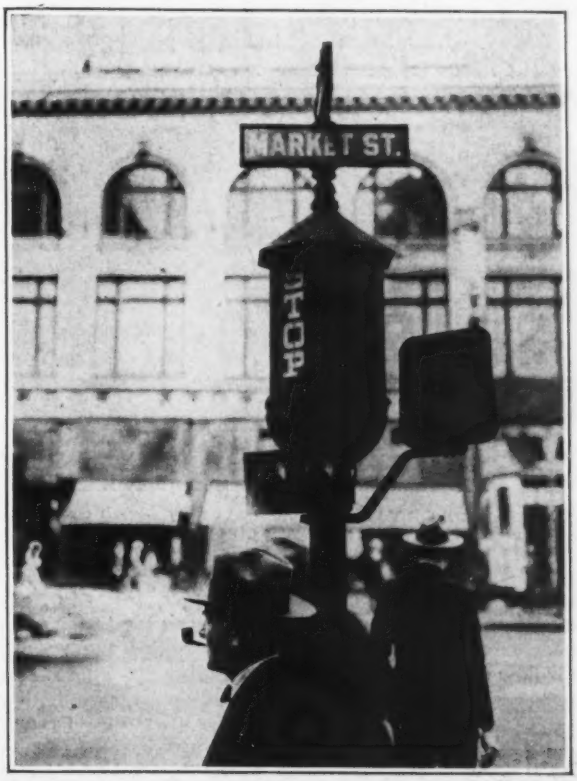
Speed of traffic in the congested district, as determined by test cars driven five times the length of each street during different hours, was found to be 10.13 m.p.h. The average speed while in motion was 11.55 m.p.h. and the waiting time 12.3 per cent of the total driving time.

Street grades have a material effect on traffic movement, numerous grades proving to be serious barriers which result in diverting traffic and concentrating it into the relatively few easy grade channels. More than one-third of the entire street length is at a grade of 5 per cent or more and 89 miles are at a grade of 10 per cent or more. Grades of 50 per cent exist, but are little used.

Here is a proper place to set down that San Francisco realizes that the securing of traffic fluidity by means of regulatory and minor physical improvements is only a first step in gaining traffic relief. The ultimate solution lies in the creation of more and better arranged street area. Definite studies along this line are being carried out by Harland Bartholomew, who has been engaged by the Traffic Survey Committee for a year's study of the street system in co-operation with the responsible city authorities. A major traffic street plan will be recommended. In the meanwhile it is Mr. Burr's duty to make the maximum use of present facilities.

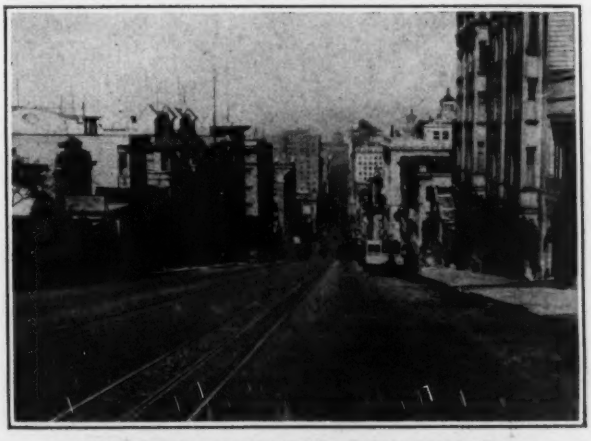
*Curb Marking*—One of the regulatory measures called for in the McClintock recommendations is the provision for marking of curbs to indicate "no parking" and "loading" zones. Certain definite lengths of curb are named by ordinance, such as 15 ft. each side of hydrants, where one may not park, also along and for 20 ft. back of paralleling safety zones. Red paint on the curb is used for no parking and yellow for loading zones, the latter meaning a maximum stop of three minutes for passenger vehicles and twenty minutes for commercial trucks.

All of these zones before designation are referred to the traffic engineer for investigation. Business necessity is balanced in each case against traffic requirements at the particular location. So far the traffic engineer's




"BIRD CAGE" STOP-AND-GO SIGNAL WITH BELLS AND SIGN FOR NO LEFT TURN ON MARKET ST.

The bells and the rotation stop-and-go signal are actuated by solenoid release, hence operating costs are extremely small. Only one stroke of the bell is given, which pedestrians easily confuse with street-car clanging. Newer models have bells inside cage.



CALIFORNIA ST. HAS 18 PER CENT GRADES

Though an 85-ft. street with 61 ft. paved it is too steep to carry heavy traffic, so angle parking is permitted. View is east from Powell.

recommendations have been scrupulously adhered to. The procedure following investigation is to report to the city engineer, who recommends action to the Board of Supervisors for passage of a resolution. All traffic enforcement and installation is in the hands of the police department, so that the order to apply the paint eventually comes to the police. The order in which work is done originates with the traffic engineer, who each day receives a duplicate report from the chief of the paint squad, giving personnel, hours worked, equipment, kind and quantity of paint used, location and length of yellow or red curbs or traffic or direction lines painted. From these records summaries are made, drawings brought up to date and costs for budget estimates prepared. Brush painting with lacquer costs about 7c. per foot of curb, painters receiving $9 per day. A dozen different kinds of lacquer are being tested on a sidewalk opposite the city hall to determine durability as to wear and maintenance of color.

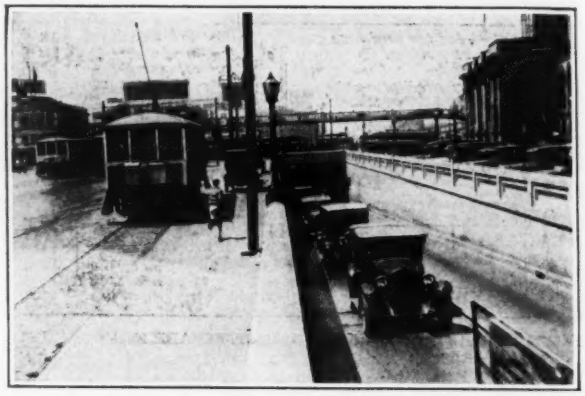
*Signals*—Installation of traffic stop-and-go signals,

POST, EAST OF VAN NESS, A HEAVY TRAFFIC STREET
Pavement width 49 ft. with 12-ft. brick center between asphalt strips for steep grades. Brick, concrete, Belgian blocks and cobbles are used in San Francisco for centers in order of steepness.

stop signals, etc., is not carried out until the traffic engineer has made traffic counts and studied the results. Ordinarily the low-count street entering the intersection must carry at least one-quarter of an average, hourly traffic of 1,000 vehicles. Counts are also utilized in the timing of the signals to the varying load throughout the day.

An appropriation of $250,000 was made this year for traffic, being five times that allowed in previous budgets. The items covered are traffic signals and timing equipment, other traffic regulatory devices, such as signs, paint markings and safety zones, additional police and equipment, and traffic engineering. The largest expenditures will go for the completion of a thoroughly flexible system of traffic signaling to move the heavy travel of the downtown area with a continuity of movement gained only by progressive timing of signals. A special system of signals for pedestrian traffic on Market St. is included. In co-operation with other city departments the traffic engineer is at work at present drawing up the many irregular five- and six-point intersections and devising possible methods of control.

*Parking Space Available*—Since parking at the curb is so intimately connected with the traffic problem as a whole, a study has been made of the available space in garages and parking lots as well as curb space. Following a questionnaire the engineer visited every garage and every block to ascertain vacant lots and basement storage utilized and possible of development. This information was then placed on a map having a scale of 100 ft. to the inch. All no-parking and loading zones are also marked. The area included covers 110 square blocks, which would accommodate 9,991 vehicles parked at the curb if all parking restrictions were removed, but only 5,102 vehicles with restrictions. These restrictions include red corner zones, curb lengths back of safety zones plus 20 ft., driveways, hydrant zones, loading zones, taxi stands and curb lengths taken by mid-block crosswalks. Garages open to the public have a stall capacity of 9,000 automobiles, and parking lots afford space for 1,610 vehicles. In vacant lots, not used but fairly well graded, is a potential storage of 2,093 automobiles. Possible space in vacant lots that could be graded would care for 1,825 cars.



EMBARCADERO SUBWAY UNDER FERRY BUILDING LOOP
Pedestrian bridge over Embarcadero from Ferry Building to Market St. makes a three-story grade separation.

*Distribution* in percentage of the 197,296 ft. of curb space providing for the 9,991 cars is as follows: Red zones, 10.8; driveway entrances, 3.4; taxi stands, 1.7; hydrant zones in which there is no parking unless attended by driver, 2.3; alleys, 21.0; red corner zones in alleys, 0.9; yellow zones, 8.5; curb length without special

LOWER MARKET ST. AND FERRY BUILDING CAR LOOP
In an eight-hour day 4,400 street cars pass here on the four tracks. Picture taken before pedestrian control was enforced.

IRREGULAR INTERSECTION OF MARKET, THIRD, GEARY AND KEARNY STS. FROM THE EAST

restrictions other than 40- and 60-minute parking limits 51.4. Including garages and lots restricted to private parties, there is a total developed and potential off-the-street storage space for 15,214 cars. On an average weekday 74 per cent of the garage stall capacity is filled and 98 per cent of the lot capacity.

In the central traffic district of 26 square blocks is the real parking problem, since few garages exist north of Market St. The distribution in percentage of the 63,-221 ft. of curb length, accommodating 3,230 cars without restriction or 1,243 cars with restrictions, is as follows: Red zones, no stopping, 11.9; driveway entrances, 0.7; taxi stands, 2.2; hydrant zones, 3.7; alleys, including all narrow streets, 25.8; red corner zones in alleys, 1.6; yellow loading zones, 15.9; curb length without special restrictions other than 40- and 60-minute parking limit, 38.2. In this area are public garages having space for 2,505 cars and private garages for 127 more. Parking lots open to the public can care for 246 vehicles. Parking lots whose use is restricted to private parties can store 62 cars. No easily convertible vacant lots exist and space obtainable by grading is found for only 12 cars.

Comparing the central traffic districts of Los Angeles and San Francisco, as noted in the accompanying table, it is found that the latter has a much higher percentage of yellow loading zones, which is the result of a greater concentration, fewer alleys which permit of back door loading and the fact that clearance zones are required adjacent to Market St. in order to facilitate the flow of traffic through the few cross-streets. In San Francisco the large amount of freight moved across the sidewalk and into sidewalk elevators is particularly noticeable. Red zones in San Francisco are 5 per cent below Los Angeles and it is contemplated to reduce their length by about one-third, adding space for 100 cars. This is to be done by reducing the red corner zones by 37½ per cent and cutting the length of zone adjacent to high-pressure fire hydrants from 30 ft. to 10 ft. Hydrants located in the middle of the blocks, where their restricted zones do not coincide with the red corner zones, account for space which would park 128 cars.

CURB RESTRICTIONS IN CENTRAL TRAFFIC DISTRICTS OF SAN FRANCISCO AND LOS ANGELES

| Item | Los Angeles, Per Cent | San Francisco, Per Cent |
|---|---|---|
| Red zones, no stopping | 20.90 | 15.66 |
| Yellow zones, loading only | 14.70 | 20.87 |
| Alleyways, entrances | 1.14 | ..... |
| Driveways, entrances | 4.71 | 0.89 |
| Taxi stands | ? | 2.91 |
| Hydrant zones | ..... | 4.93 |
| Montgomery St., loading only | ..... | 4.61 |
| Parking, 40 minutes | 58.55 | 50.13 |
| Totals | *100.00 | *100.00 |

*Los Angeles has 109,152 ft. of curb and San Francisco 48,139 ft.

DOUBLE PARKING EVIL ON MARKET ST.
Fluid traffic on this 120-ft. street is cut to a single lane on one side, as autoists cannot drive on two (center) of the four tracks.

BEFORE PEDESTRIAN CONTROL AT MARKET, FOURTH, ELLIS AND STOCKTON STS.
Market St. is immediately below parallel with long button-marked pedestrian lanes. In upper left one track of Stockton St. car line ends. Cars turn back here, forcing autos to the left. No parking permitted to right, but there is a loading zone!

*Finding Parking Space*—Each day sees more than 81,000 vehicles enter the central traffic district from 8 a.m. to 6 p.m. and only 1,243 can park. All available space is utilized to more than 90 per cent of its capacity from 9:15 a.m. to 5 p.m. The average parking time at the curb is 59 minutes, even though the ordinance specifies 40 minutes. If all parking regulations were removed, but 32,000 of the 81,000 could find a place to stop. To allow this large number of vehicles an opportunity to reach the curb it is necessary to place a very short time limit for stopping on certain curb lengths, the yellow loading zones. If a loading zone has but ten vehicles a day enter it from 8 a.m. to 6 p.m. it has served during the day the same number of cars as if it were unmarked and permitted 60-minute parking. However, if only ten vehicles were to use a loading zone per day it would be used only about two hours—that is, if most of them were commercial vehicles. For a loading zone to be constantly in use up to the maximum time allotted for each vehicle, it can accommodate between 30 and 200 vehicles depending on the percentage of trucks and passenger cars. Used to capacity, the loading zones of San Francisco central traffic district can serve approximately 56,000 vehicles daily, or about twice the total parking possibilities, if all restrictions except 40-minute parking were removed.

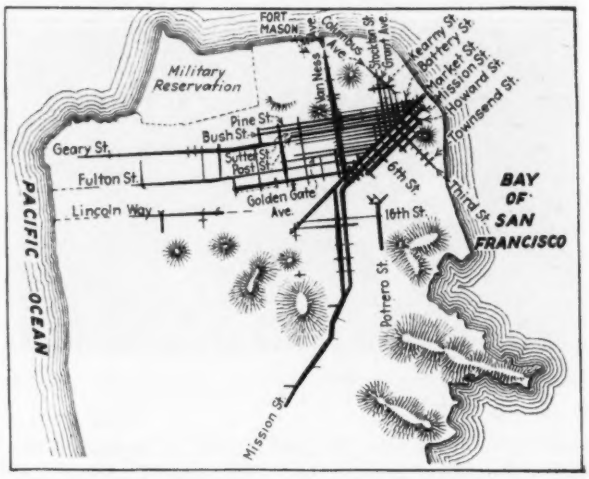
This, then, is the street relief furnished the district by engineering study. Off-street storage will furnish other relief. More than half of the total storage in the district is now in garages and parking lots. It does not take the place of the curb for commercial deliveries, but it takes the automobiles off the street so that the commercial vehicle can reach the curb and function.

*Special Cases*—Certain special situations in San Francisco give the traffic engineer plenty of chance for exercise of ingenuity. The Embarcadero, under the State Harbor Commission, fronting on the waterfront piers, is extremely wide, varying at different points. At the foot of Market St. most of the street cars of the city turn back uptown. An outsider would say San Francisco is suffering badly from its multiplicity of street-car lines so far as real use of Market St. is concerned. He cannot understand giving up the main thoroughfare to four tracks when the load averages but seventeen per car at Third and Market and only six at the ferry, with cars running practically empty much of the day. An overhead passenger viaduct has been installed across the Embarcadero, but it is not used as much as was expected. People still stream across the street almost indiscriminately. On the Embarcadero away from Market St. the movement of mixed traffic of automobiles and trucks has been straightened out into fast and slow lanes by painted stripes, yellow for the center and white for the others.

VAN NESS AVE. CARRIES MOST TRAFFIC
Diagonal parking is permitted, but is soon to be abolished. Note wide spread of traffic.

Van Ness Ave., as noted, carries the heaviest traffic in the city. It has a width of 125 ft. and is devoted mainly to automobile salesrooms. Pedestrian traffic is small. Diagonal parking has been permitted but is unlawful and will soon be abolished. Many people drive the front wheels over the curb onto the outer unused portion of the sidewalk, a distinct violation of the law that seems to be in the interest of the fluid traffic, hence is permitted.

Striping of streets with lanes generally has not been practiced, because it is felt applicable only to long stretches. On the other hand, a profusion of button lane markings for pedestrians in the central traffic district makes for an endless amount of confusion and uncertainty.

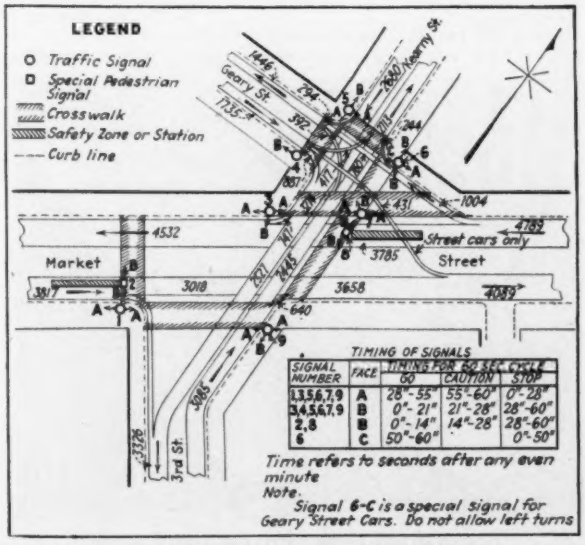



RELATIVE VEHICULAR TRAFFIC FLOW ON THE PRINCIPAL TRAFFIC ARTERIES OF SAN FRANCISCO

*Pedestrian control* has only recently been inaugurated. Fines of $1 for violation of the signals and for jaywalking are paid over the counter. Five times the revenue is collected now as compared with former court procedure. The two-light stop-and-go signals with a single weak bell stroke for the pedestrian to proceed for seven seconds ahead of vehicular traffic work well. Much of the system is on a 72-second cycle. Los Angeles has found that pedestrians will wait less than 40 seconds for signals, after which even police cannot hold them on the sidewalk. The new pedestrian controls for Market St. are now being worked out and will doubtless show many improvements over the present hard-to-see-and-hear installations.

The two principal factors which have helped to relieve traffic in San Francisco are pedestrian control and the gradual elimination of double parking by the installation of loading zones. The automobile death rate is coming down, the city being one of the four large cities of the country to show such a record. Property damage is less by $2,000,000 annually and speed has been increased. Much still remains to be done in traffic regulation.

Improvements can be made fast enough, it is felt, to


LEGEND
Traffic Signal
Special Pedestrian Signal
Crosswalk
Safety Zone or Station
Curb line
Kearny St.
Geary St.
Market
Street
Street cars only
3rd St.
TIMING OF SIGNALS
SIGNAL NUMBER | FACE | TIMING FOR 60 SEC. CYCLE: GO | CAUTION | STOP
1,3,5,6,7,9 | A | 28"-55" | 55"-60" | 0"-28"
3,4,5,6,7,9 | B | 0"-21" | 21"-28" | 28"-60"
2,8 | B | 0"-14" | 14"-28" | 28"-60"
6 | C | 50"-60" | | 0"-50"
Time refers to seconds after any even minute
Note: Signal 6-C is a special signal for Geary Street Cars. Do not allow left turns

VEHICULAR TRAFFIC FLOW AT AN IRREGULAR INTERSECTION AND RECOMMENDED CONTROL

keep up with increased motor registrations so as to hold back the congestion until the physical changes being studied by Mr. Bartholomew are made and those now under way finished, the latter having been planned and executed by M. M. O'Shaughnessy, city engineer.

The Traffic Survey Committee, which is a non-political organization of 84 citizens appointed by the mayor, thoroughly representative of the business interests most concerned with the street traffic problem, has been underwritten enthusiastically for its second year of activity. Its main work on traffic control this year will be advisory and educational through the activities of its engineer, Theodore Matson, and Dr. Miller McClintock, director. Gradually upon the office of the traffic engineer, George D. Burr, will fall these responsibilities to be worked out in co-ordination with the departments of engineering, police, electricity and such others as are concerned.

## Visibility Over Vertical Curves on Highways

The importance of increasing the length of roadway that the driver of an automobile can see ahead of him was a factor in the recent reconstruction of a vertical curve in the approach of the Yolo causeway in California. The approach as originally built was satisfactory so far as grade was concerned, but it became much safer when the visibility was increased from less than 500 ft. to more than 1,500 ft., according to a description of the work in *California Highways and Public Works*, the monthly bulletin of the California Division of Highways.

The grade line of the causeway is 6 ft. above that of the paved highway leading to it. The approach or runoff at the west end of the causeway was originally built on a vertical curve less than 75 ft. in length. Vehicles traveling west across the 3-mile causeway approached this runoff at a high rate of speed and the short sight distance due to the vertical curve thus created a serious traffic hazard. Reconstruction of the causeway approach included a non-skid paving, a new and heavier type wheel guard and lowering enough of the trestle bents to increase the length of the vertical curve from 75 ft. to 400 ft.

The work was done without interrupting traffic by maintenance forces of the Highway Commission at a total cost of $550. The piles were cut off just below the caps, the lengths of piling removed in the various bents varying from 1 in. to 2 ft. As the cutoffs were made the floor system was supported temporarily on 4x12-in. shims placed between the top of each pile and the cap, the shims being held firmly in place by scabs nailed to both caps and piles.

When all the bents were thus supported, the deck was gradually lowered to its new position by removing the shims, 4 in. at a time, and letting the deck down on jacks.

## High-Speed Concrete Pouring on Pardee Dam

In the construction of the Pardee dam for the East Bay Municipal Utility District in California, concrete pouring is carried on for two eight-hour shifts daily. Using four 2-cu.yd. mixers, the most rapid rate of pouring thus far has been 3,300 cu.yd. for sixteen hours; the greatest quantity of concrete placed in the dam in a calendar month was 67,000 cu.yd.

# Tests Yield Formulas for Steel I-Sections in Torsion

### Factors of Torsional Stress and Stiffness Found in Terms of Moment, Modulus of Rigidity, Shear and Radian Rotation Angle

By William B. Campbell
*Northwestern University, Evanston, Ill.*

THE results of a series of torsion tests on steel I-beams made at the University of Toronto were discussed by Dr. L. B. Tuckerman of the Bureau of Standards in *Engineering News-Record*, Nov. 27, 1924, page 882. During the academic year 1926-27 some similar tests were made at the school of engineering of Northwestern University, in which sixteen I-sections ranging in depth from 3 to 12 in. were used. For depths of 4, 5, 6, 7, 8, 9 and 10 in. two beams were tested, one of maximum and one of minimum weight. For depths of 3 in. and 12 in. one beam of each depth was used, that of minimum weight.

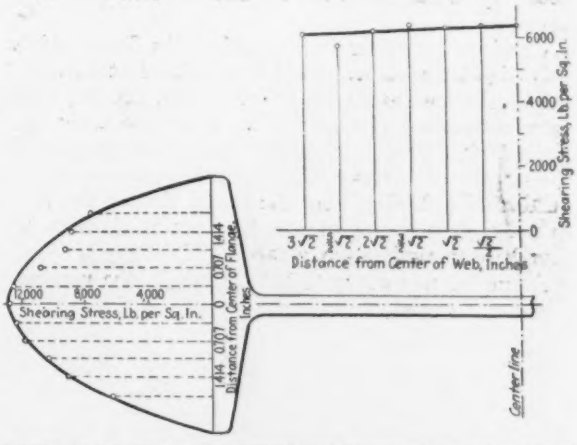
For each of these beams observations were made to determine a torsional stiffness factor, $J$, and a torsional stress factor, $S$. The first of these is defined by the equation,

$$J = M \div \theta N$$

where $\theta$ is the rotation in radians per inch of length produced by a torsional moment, $M$, in inch-pounds and $N$ is the shear modulus of rigidity in pounds per square inch. The torsional stress factor is defined by the equation

$$S = M \div s$$

where $s$ is the maximum shearing stress on a cross-section.




TYPICAL DIAGRAM SHOWING DISTRIBUTION OF STRESS IN I-SECTION SUBJECT TO TORSION

The specimens used were standard I-sections 4 ft. in length. Both ends were bolted by four bolts through the flanges to connecting angles, which were bolted to the face plates of the testing machine. Punch marks 9 in. from each end and exactly 30 in. apart were made on the center lines of each flange. Rectangular frames carrying small mirrors were attached to the specimens by means of pointed screws inserted in the punch marks. This arrangement caused the frame and mirror to rotate with a line perpendicular to the longitudinal axis and

passing through the center lines of the flanges. To determine the rotation of one frame relative to the other, a scale of 200 cm. radius and a telescope were placed at that distance from each mirror and the deflections of the images in the mirrors were read by means of the telescopes.

The strain measurements were made by means of the Northwestern 1-in. strain gages described in *Engineering News-Record* for June 3, 1926. Three sets of two perpendicular 1-in. gage lines were laid off on each flange with their intersections lying on the center lines of the flanges and inclined at 45 deg. to the longitudinal axis of the beam. Strain gage observations were made for all six gage lines on each flange for increasing and decreasing torques and the means taken as the final determination. To reduce the gage readings to stresses the dial divisions of the gage were first multiplied by the gage factors in order to obtain the strains. Since the specimen is in torsion, the strains measured are the principal strains and the following equation is true:

$$e_u = q(1/E + 1/mE)$$

where $e_u$ is the principal tensile strain, $q$ the maximum shearing stress, $E$ Young's modulus, and $1/m$ Poisson's ratio. In determining the stresses, $E$ was assumed to be 30,000,000 lb. per square inch and $m$ equal to 4. Hence $q = 24{,}000{,}000\, e_u$.

A strain gage can be used to measure only the average strain for the length of the gage line and cannot be used directly to measure the strain at a point. Since the strain at the center of the flange was desired, it was necessary to determine the variation of strain across the flanges.

One-inch gage lines were placed on the flange at intervals of ½ in., measured on a line inclined at 45 deg. to the longitudinal axis of a 12-in. section, and the strains were determined for each line. The curves, shown in the sketch, found by plotting the average stresses for the lengths of the gage lines as ordinates and the perpendicular distances from the center line of the flange to the centers of the strain gage lines as abscissas was found to approximate a parabola.

Assuming this curve to be a parabola, the maximum stress at the center of the flange, $q_m$, can be expressed by the equation

$$q_m = \frac{q_o}{1 - \frac{1}{6b^2}}$$

where $q_o$ is the average stress for the length of the gage line which is symmetrical with the center line of the flange, and $b$ is the flange width. For a 3-in. beam $q_m = 1.03\, q_o$ and for a 12-in. beam $q_m = 1.006\, q_o$.

A similar procedure applied to the web indicated that the shearing stress in the web was constant at all points. The results of the stress determinations for the web are shown in the sketch.

In the report of the tests made at the University of Toronto it was stated that the maximum shearing stress in an I-section under torsion occurred at the centers of the flanges if the average thickness of the flanges was greater than the web thickness and at the center of the web if the web thickness was greater than the average flange thickness. In order to verify this statement, stress determinations were made on the surface at the center lines of the webs of several specimens. In no case was the web stress found to be as large as the stress in the flange, and the conclusion is apparently untrue for the sections tested.

The accompanying table contains a summary of the data. In column 2, $m$ is the flange thickness at the point where the web and flange would intersect if they were extended beyond the fillet. This value was obtained by measuring the thickness at the point where the flange joins the fillet and by adding one-sixth the radius of the fillet. In column 3, $n$ is the flange thickness at its edge. These values were obtained by measuring the thickness at the point where the fillet joins the inside face of the flange and subtracting from this value one-sixth of the fillet radius. This gives the thickness at the extreme edge where the straight lines of the boundary would intersect. Column 6 is the mean flange width, $f$, minus the web thickness, $t$. Columns 10 and 11 are the maximum shearing stresses in the flanges and webs, respectively, for an increment of moment, $M$. In obtaining these values, Young's modulus and Poisson's ratio are assumed as 30,000,000 lb. per square inch and ¼, respectively. The stress factor, $S$, and the torsional stiffness factor, $J$, in accordance with the formulas already stated are given in columns 12 and 13. In this computation the shearing modulus, $N$, was assumed as 12,000,000 lb. per square inch.

Column 14, $J'$ is an estimate of $J$ from a formula suggested by Dr. Tuckerman and slightly modified by the writer—that is,

$$J' = \tfrac{1}{3}\, dt^3 + \tfrac{1}{12}(m + n)^3(f - t)$$

It is evident from a comparison of the values of $J$ and $J'$ that values of $J'$ are too small. The average discrepancy between $J$ and $J'$ is 20 per cent and in column 15 the values designated by $J''$ are the values of $J'$ multiplied by this factor. The proposed formula then becomes $J'' = 0.4dt^3 + 0.1(m + n)^3(f - t)$.

RESULTS OF TORSION TESTS ON I-SECTIONS

| 1 Beam Depth and Nominal Weight, In. Lb. | 1a Actual Weight Lb. Per Foot | 2 Flange Thickness m, Inches | 3 n, Inches | 4 Web Thickness t, Inches | 5 m + n Inches | 6 f − t Inches | 7 Main Depth of Section d Inches | 8 Increment of Moment M In. Lb. | 9 Angle of Twist, θ, Rad. Per In. | 10 Max. Stress in Flange Lb. Per Sq. In. | 11 Stress in Web Lb. Per Sq. In. | 12 Stress Factor, S, In.³ | 13 Stiffness Factor, J, In.⁴ | 14 Stiffness Factor, J′ In.⁴ | 15 Stiffness Factor, J″ In.⁴ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3— 5.7 | 5.53 | 0.360 | 0.143 | 0.180 | 0.503 | 2.14 | 3.01 | 1,000 | 0.00226 | 9,180 | .... | 0.109 | 0.0368 | 0.0284 | 0.0352 |
| 4— 7.7 | 7.62 | 0.392 | 0.168 | 0.200 | 0.560 | 2.49 | 4.00 | 2,500 | 0.00283 | 14,280 | .... | 0.175 | 0.0736 | 0.0472 | 0.0567 |
| 4—10.5 | 10.53 | 0.418 | 0.185 | 0.407 | 0.603 | 2.39 | 4.00 | 5,000 | 0.00245 | 14,380 | 12,130 | 0.383 | 0.1701 | 0.1335 | 0.1605 |
| 5—10.0 | 10.15 | 0.432 | 0.193 | 0.235 | 0.625 | 2.79 | 5.02 | 3,500 | 0.00249 | 13,930 | .... | 0.251 | 0.1170 | 0.0785 | 0.0944 |
| 5—14.75 | 15.00 | 0.459 | 0.200 | 0.503 | 0.659 | 3.77 | 5.01 | 6,500 | 0.00161 | 10,500 | 9,220 | 0.619 | 0.3360 | 0.3023 | 0.364 |
| 6—12.5 | 12.19 | 0.495 | 0.207 | 0.216 | 0.702 | 3.05 | 6.09 | 6,800 | 0.00340 | 10,650 | .... | 0.638 | 0.1667 | 0.1084 | 0.1305 |
| 6—17.25 | 17.40 | 0.515 | 0.227 | 0.500 | 0.742 | 3.00 | 6.01 | 7,500 | 0.00154 | 11,290 | 7,800 | 0.665 | 0.4040 | 0.3526 | 0.424 |
| 7—15.3 | 15.50 | 0.558 | 0.235 | 0.285 | 0.793 | 3.36 | 7.05 | 4,500 | 0.00149 | 9,560 | .... | 0.470 | 0.2510 | 0.1949 | 0.234 |
| 7—20.0 | 20.33 | 0.568 | 0.240 | 0.463 | 0.808 | 3.42 | 7.03 | 7,500 | 0.00139 | 10,100 | 6,125 | 0.742 | 0.4510 | 0.3820 | 0.459 |
| 8—18.4 | 18.29 | 0.622 | 0.273 | 0.266 | 0.895 | 3.64 | 8.08 | 11,500 | 0.00264 | 18,450 | .... | 0.642 | 0.3625 | 0.2680 | 0.322 |
| 8—25.5 | 25.45 | 0.612 | 0.263 | 0.545 | 0.875 | 3.60 | 8.00 | 13,500 | 0.00151 | 12,150 | 9,460 | 1.110 | 0.7470 | 0.6310 | 0.759 |
| 9—21.8 | 21.83 | 0.625 | 0.272 | 0.310 | 0.897 | 4.00 | 8.99 | 9,000 | 0.00166 | 12,750 | .... | 0.705 | 0.4510 | 0.3270 | 0.393 |
| 9—35.0 | 33.65 | 0.627 | 0.262 | 0.704 | 0.889 | 3.90 | 8.96 | 14,500 | 0.00091 | 8,510 | 6,750 | 1.820 | 1.3220 | 1.2690 | 1.523 |
| 10—25.4 | 25.00 | 0.688 | 0.278 | 0.308 | 0.966 | 4.33 | 10.04 | 11,000 | 0.00155 | 12,270 | .... | 0.897 | 0.5900 | 0.4230 | 0.508 |
| 10—40.0 | 39.50 | 0.683 | 0.278 | 0.734 | 0.961 | 4.27 | 10.04 | 25,000 | 0.00116 | 11,280 | .... | 2.220 | 1.8000 | 1.6380 | 1.970 |
| 12—31.8 | 32.30 | 0.705 | 0.335 | 0.390 | 1.040 | 4.50 | 12.01 | 17,000 | 0.00150 | 12,610 | 6,350 | 1.345 | 0.9410 | 0.6600 | 0.794 |

# Largest Activated-Sludge Plant in the World

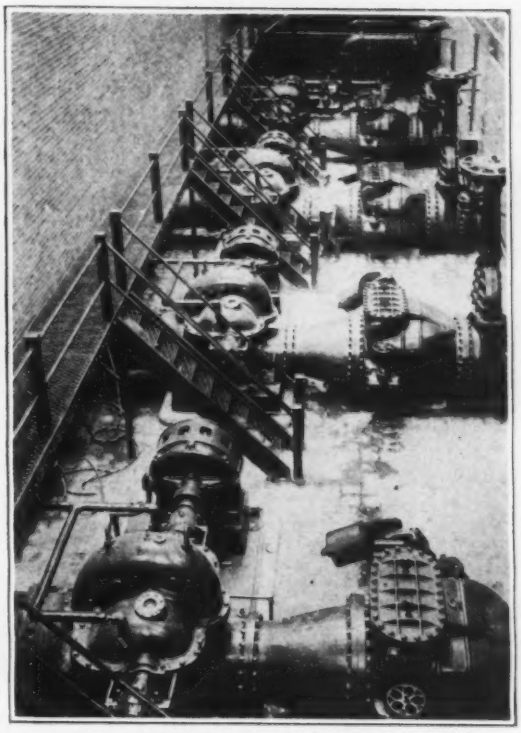
## Chicago Sanitary District Opens Works to Treat 175 M.G.D. of Sewage From 830,000 People—Sludge Pumped 18 Miles

ON OCT. 3, the Sanitary District of Chicago put in operation the new North Side sewage works, which are the largest activated-sludge works ever built. Their design and operation were described by E. J. Kelly, chief engineer of the district, in *Engineering News-Record* of March 11, 1926, p. 394.

These works, covering an area of 97 acres, are to handle mainly domestic sewage from an area of 78 square miles, including the northern section of Chicago, the city of Evanston and several small towns. They are designed for a 1930 population of 830,000 with an average sewage flow of 175 m.g.d. but certain portions which cannot easily be extended are built to serve a 1960 population. The plant is set at such an elevation as to balance cut and fill in construction. Its location is shown in the accompanying illustration.

An interesting feature is the preliminary settling and skimming of the sewage as a preparatory treatment. From an intake chamber the sewage is pumped through a 12x12-ft. conduit to grit chambers and screens having 1-in. openings. It flows then to eight preliminary settling tanks, from which it passes through three venturi meters to three batteries of aerating tanks, totaling 36 tanks, where it is treated with compressed air at about 7-lb. pressure, supplied by seven motor-driven turbo-blowers. These aerating tanks have sprial flow, with surface baffles. The diffuser containers are set above the floor of the tank and are provided with drains.

From these tanks the aerated sewage goes then to the 30 final settling tanks, beyond which is a drop chamber and outfall conduit delivering the final effluent to the North Shore drainage canal and thus to the north branch of the Chicago River.

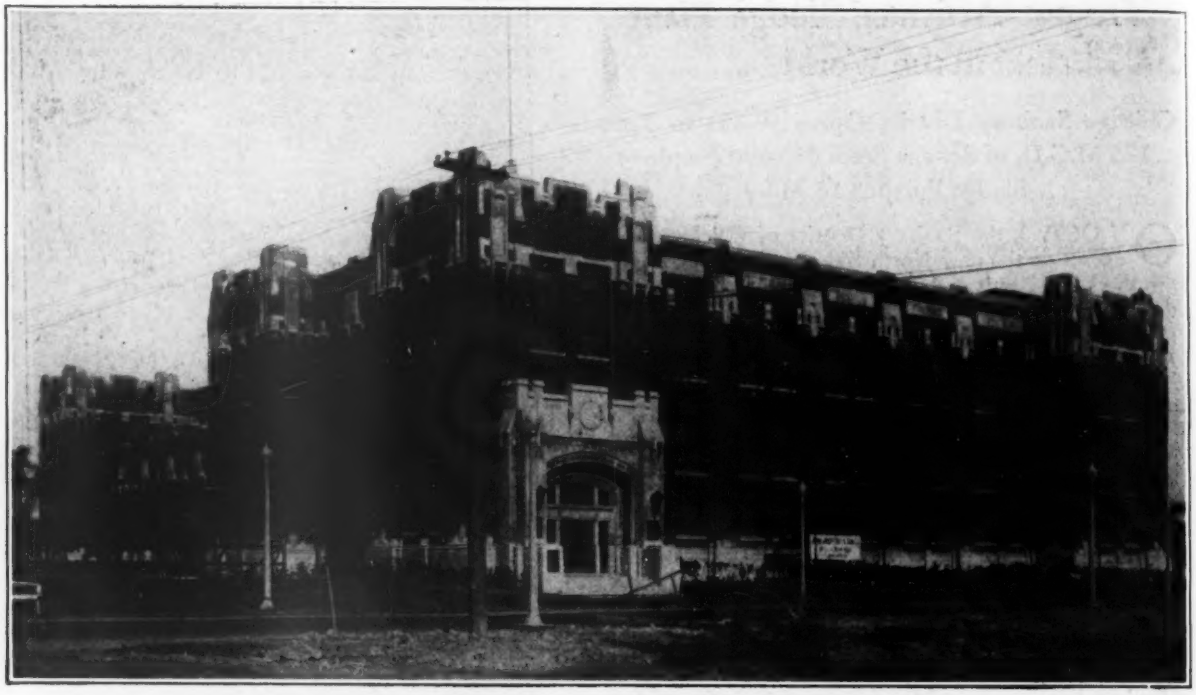


ELECTRICALLY DRIVEN SLUDGE RETURN PUMPS
These four pumps return sludge from the final settling tanks to the aerating tanks.

All pumps are of the centrifugal type and motor driven. Five pumps of 150 and 100 sec.-ft. capacity deliver raw sewage to the grit chamber. Four pumps of 5,400 to 13,500 g.p.m. capacity each, at different speeds, return sludge from the final settling tanks to the aerating tanks.

Chicago Aerial Survey Company

NORTH SIDE ACTIVATED-SLUDGE PLANT
At left, in succession: Sewage pumping station; grit chamber house; preliminary settling tanks; office building, which contains also the laboratories and sludge pumps. In center: Electrical substation; service building; aerating tanks. On the right: Operating galleries and final settling tanks.



PUMP AND BLOWER HOUSE FOR NORTH SIDE SEWAGE-WORKS

For the excess activated sludge and the sludge from the preliminary settling tanks three 1,000-g.p.m. pumps discharge into a 14-in. cast-iron force main 18 miles long, which delivers the sludge at practically constant flow to the Imhoff tanks at the new West Side sewage-works, now partly built. These tanks provide capacity for sludge digestion of 2 and 5 cu.ft. per capita for the west side and north side areas respectively. The sludge will be air dried, stripped from the drying beds by machine and dumped on an area of about 900 acres reserved for this purpose. No attempt is to be made to produce commercial fertilizer.

INTERIOR OF ONE DIVISION OF AERATING TANKS
Two rows of filtros plates at one side of bottom of tank give spiral flow to sewage.

Power is supplied from transmission lines at 12,000 and 33,000 volts. All the large motors are of the synchronous type, operating at 6,600 volts. The works are notable for the liberal use of electrically operated devices, such as meters, gate valves and controls. The devices for measuring the flow of sewage and air are both indicating and recording, with extensive duplication of essential control instruments. Ratio recording instruments are provided also. In the design of the plant special care was given to provide for careful and thorough control.

The North Side sewage-works were designed and built under the direction of E. J. Kelly, chief engineer, Sanitary District of Chicago; Philip Harrington, principal assistant chief engineer; Horace P. Ramey, assistant chief engineer, and Langdon Pearse, sanitary engineer. Others of the technical staff include George M. Wisner, consulting engineer; L. C. Whittemore, engineer of treatment plant design; I. P. Kane, designing engineer for treatment plants; F. W. Mohlman, chemist; H. I. Steffa, mechanical engineer; J. T. Hawley, electrical engineer, and F. L. Finlayson, architect. The construction work was in charge of William H. Trinkaus, construction engineer, with B. J. Curtis as resident engineer. The general contractor for the greater part of the work was the John Griffiths & Son Company. The total cost of the works, including land and engineering, is about $19,000,000.

# Replacing Pavement After Removal of Street Car Tracks

## Return of Streets to Municipality by Car Company Involves Novel Method—Ties Left in Place

CAR tracks on 6½ miles of streets in Salt Lake City are being removed. An excessive mileage existed, and the dwindling traffic induced the company to seek relief from Utility Commission. On certain streets the privilege of operating trackless trolleys was retained. In accordance with its franchise from the city the company is obligated to return the streets to the city with pavement as good as the asphalt pavement adjacent to the tracks. In the early negotiations it was proposed that ties as well as rails should be removed and new foundations laid. This was not done. The ties have been left in place, also as much asphalt as was not shattered was left between the rails and in the center strip. Methods of construction and some of the completed paving were

FIG. 1—CUTTING AN EDGE AND REMOVING DEBRIS
The rails and some of the blocks have been removed. Ring on roller wheel cuts an even edge.

recently inspected by a representative of *Engineering News-Record*. Just how long the ties will remain without rotting, and the thick and thin strips of asphalt without furrowing, is a question seriously asked in Salt Lake. Whether the sealing effect of the tight asphalt cover will accelerate or retard the rotting is the question.

After removal of the rails and abutting stone block headers the edges of the asphalt along the roadway were cut straight by a cutter ring on the wheel of a road roller. The three strips between the rails were trimmed with compressed air spade drills to eliminate the shattered portions. This completed, the débris, including the dirt washed down into the pavement alongside the rails, between cracks in the pavement and between header blocks, and some of the loose ballast

FIG. 3—SPADE CUTTER TOOL SAVED SMALL AREAS OF GOOD PAVEMENT

were removed. Finally all loose dirt was washed and brushed away from the old asphalt.

Some of the paving blocks were placed between the ties on the old ballast, and concrete was filled in to the level of the old binder course. Edges of the old asphalt were painted with liquid asphalt and new top course material was then placed over the concrete and strips of old asphalt. The new material was about 1½ to 2 in. thick where it abutted against the old pavement. Over the narrow strips between the rails and the center strip the thickness was from ½ to ¾ in. These varying depths made effective rolling difficult and may lead to furrows under heavy traffic. This procedure produced a slight crown, more than is customary, to which is attributed the observed fact that drivers largely refrain from using the center of the road, although a drive over most of the mileage completed at the end of June indicated better riding qualities than in the old roadways.

FIG. 4—EVEN ROLLING OF DIFFERENT THICKNESSES PROVED DIFFICULT
Concrete base was brought up to level of original binder course.

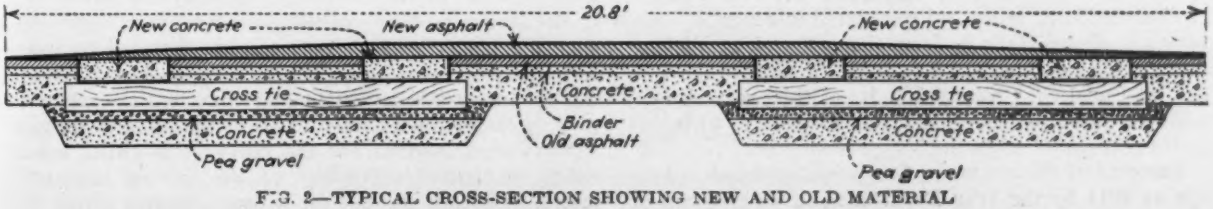



FIG. 2—TYPICAL CROSS-SECTION SHOWING NEW AND OLD MATERIAL

# Chicago Bascule Bridge Erected Over Railroad Tracks

## Double-Leaf 204-Ft. Highway Bridge Is Built on Dry Land, Over Site for New Channel of Chicago River—Heavy Foundation Work—Steel Erection Carried On Under Traffic

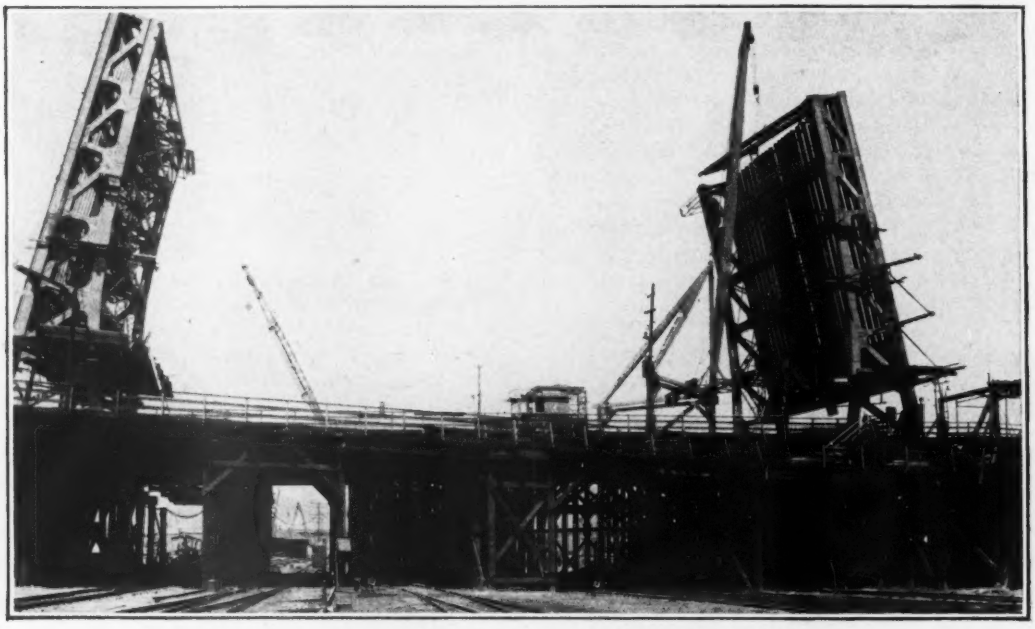


FIG. 1—ROOSEVELT ROAD BASCULE BRIDGE, CHICAGO
Located on site for straightened river channel. End of old swing bridge at right. Temporary viaduct carries street. Railway and highway traffic maintained during bridge construction. Note stiff-leg derrick mounted above street and placing floor beam of east leaf.

BUILDING a large double-leaf bascule bridge over dry land occupied by railway tracks while at the same time maintaining traffic on the street viaduct crossing these tracks was a difficult job which has been carried out successfully at Chicago as part of the preliminary work in the project for straightening the Chicago River. At Roosevelt Road the new channel (not yet excavated) will be west of the existing channel and the new bascule bridge is clear of the old three-truss swing bridge.

A steel viaduct carrying Roosevelt Road (formerly Twelfth St.) over the groups of main tracks and yards was built in 1886, with a 220-ft. through-truss swing bridge spanning the river. In 1911 it was decided to widen this important street from 66 ft. to 118 ft. and to build a new viaduct of this width. In order to maintain traffic the viaduct was built in two independent parallel sections, as described in *Engineering News-Record* of Aug. 20, 1925, p. 297. Owing to market conditions, the first section was built of reinforced concrete and the second section of structural steel cased in concrete. The length is about 2,000 ft. from the east end, at Wabash Ave., to the river and 1,400 ft. from the river to the west end, at Canal St. Nearly 300 ft. of this west viaduct, however, is of timber construction at present, to be rebuilt permanently when the bridge is finished.

Removal of the old swing bridge was ordered as long ago as 1911 by the War Department in its program of eliminating center-pier bridges as obstructions to the navigation of the Chicago River. But with the World War and then the city plan for straightening and improving the river, this bridge has been allowed to continue in service and will now remain until the new channel is opened. In 1924, however, it was moved about 52 ft. downstream to a temporary timber pier, in order to line up with the first half of the new viaduct and to clear the way for removal of the old masonry center pier and abutments. This new position provided a navigable channel on only the east side of the pier, and in order to support the pier against blows from passing vessels it was braced by a pair of steel girders extending to the west bank and having a concrete slab walk placed between them.

The general situation is shown in Fig. 1, with the new bascule bridge practically completed, as erected in its open position, and with the temporary timber viaduct passing through it. In Fig. 3 is shown the location of the new and old substructures and superstructures.

*Substructure*—Each substructure for the new bascule span has ten cylindrical concrete piers founded on bedrock, six supporting the massive concrete box forming the tail pit or counterweight pit, while two at each end carry a concrete deck slab. Two of the piers in the pit support steel columns for the heavy cross-girder upon which the trunnion bearings of the bascule span are seated. Beneath the tail pit a deep concrete girder is

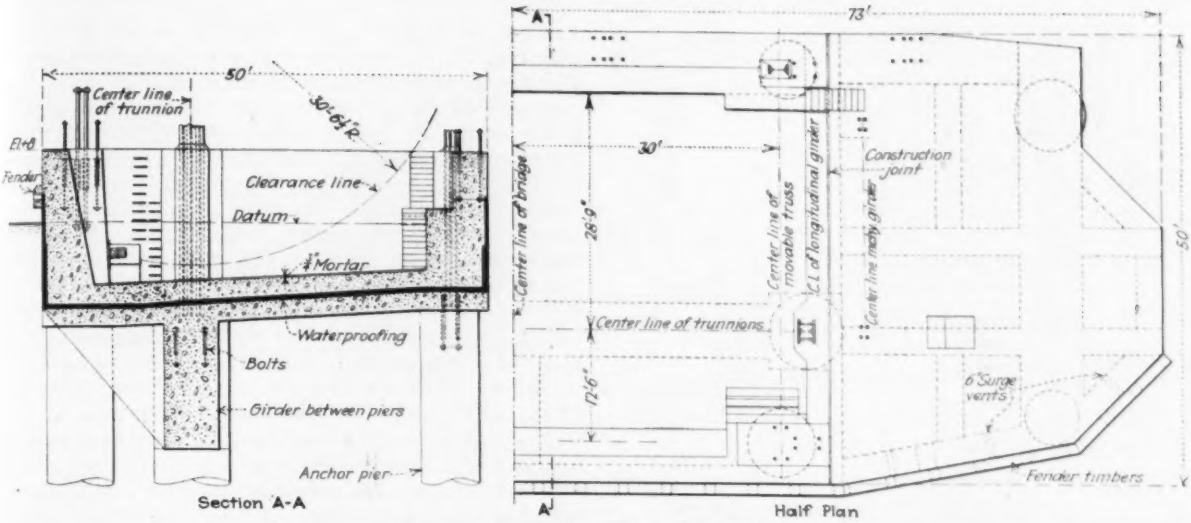



FIG. 2—EAST PIER OF BASCULE BRIDGE

formed between these piers, with a bracket from each pier to the face of the tail-pit box.

The east pier is shown in Fig. 2, and the west pier is practically identical with it. In plan it is approximately 146x50 ft. over all, the central portion forming the counterweight pit 71x28 ft. 9 in. and 12½ to 15 ft. deep. Beyond this pit, supported by the pit walls and the outer cylinder piers, is a system of girders with a concrete slab deck. For ventilation and to prevent pressure under the slab decks at the ends of the pier, due to waves from passing vessels trapping air in the pockets between the girders, there are 6-in. air holes or surge holes in the girders forming the face of this part of the structure.

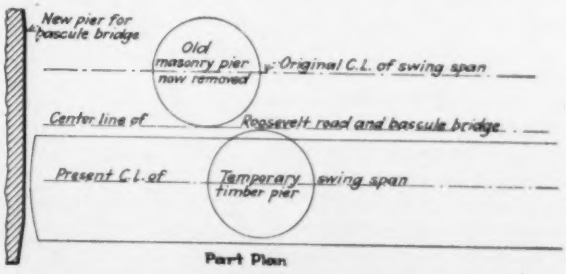
Owing to the high level of the bridge and viaducts, 33 to 36 ft. above the water, the counterweight pits are shallow, having the bottoms 12 and 14 ft. below waterline for the east and west sides, respectively, or 10 to 12 ft. above the bed of the future channel. This feature necessitated special construction in the masonry to prevent earth under the pit from slipping into the channel. This was provided for by a deep concrete rib or girder under the pit and between the cylinder piers carrying the trunnion bearings. Beyond the ends of the pit, timber and concrete bulkheads or dock walls were built for the same purpose.

*Tail Pit*—To insure watertightness, the concrete was made with a rich mixture and well tamped. The bottom is made with two 24-in. layers of concrete, separated by a 6-in. layer of cement mortar as waterproofing. This 6-in. mortar course is carried up against the outside of the walls for some distance and is then reduced to a 4-in. thickness, which extends above the water line. The floor of the pit is finished with a ¾-in. coat of cement mortar. A sump and electric pump provide for handling any water in the pit.

Against the inside of the river wall of the pit, at each end, are bolted two 12x12-in. timbers 8 ft. long. These engage bumpers on the trusses when the bascule leaf reaches its full open position. On the outside the river wall is protected against blows from ships by means of a fender consisting of two lines of 12x12-in. creosoted oak timbers, separated by 12-in. spacing blocks and secured by anchor bolts embedded in the concrete. Washers 6x6 in. and 1 in. thick on these bolts keep the timbers 1 in. from the concrete wall, to prevent water from collecting so as to cause rotting.

*Pile and Concrete Bulkheads*—At the end portions of the pier, beyond the tail pit, the concrete girders carrying the deck slab extend only 2.5 ft. below the waterline. Below them the space is closed and the fill retained by a bulkhead of timber and concrete construction shown in Fig. 4.

A row of 35-ft. wood piles backed by 8x12-in. stringers and Wakefield 9-in. triple-lap sheet piling supports a reinforced-concrete cap 5x4 ft., the top of which


New pier for bascule bridge
Old masonry pier now removed
Original C.L. of swing span
Center line of Roosevelt road and bascule bridge
Present C.L. of Temporary timber pier swing span
Part Plan

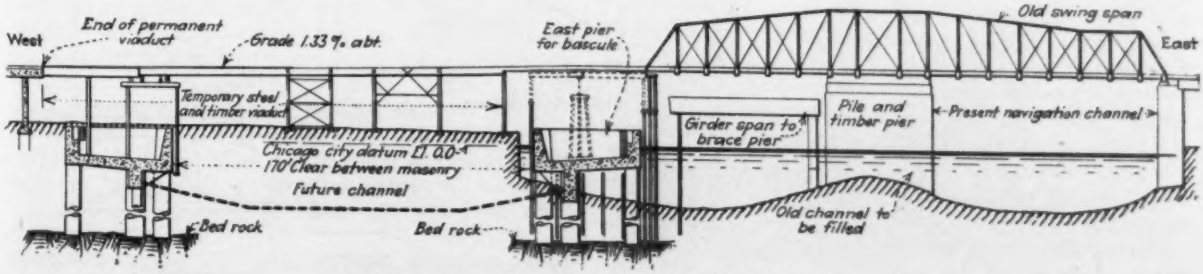



FIG. 3—LOCATION OF OLD AND NEW BRIDGES

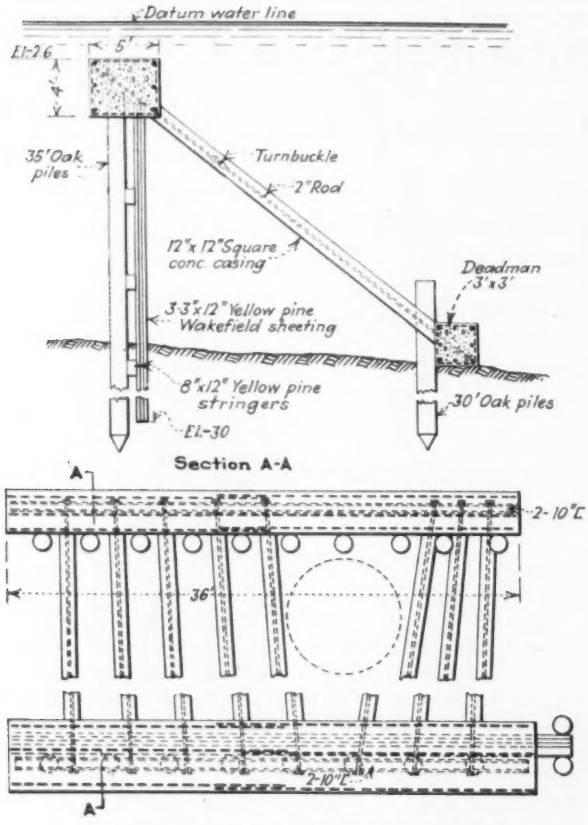



FIG. 4—PILE AND CONCRETE BULKHEAD

is 2.6 ft. below waterline. To this cap are attached diagonal tie-rods extending down to a concrete beam or deadman 3x3 ft., built against a row of 30-ft. anchor piles. At top and bottom these rods pass between pairs of 10-in. channels, to which they are secured by nuts and washers. The channels and rod ends are embedded in the concrete, while between the two beams each rod is cased in concrete 12x12 in.

*Foundation Conditions* — The cylindrical foundation piers were built in wells sunk in open excavation by hand. Vertical timber lining of each 5-ft. lift was secured by interior ring braces, in the manner usually employed for such foundation piers in Chicago. All piers are carried down to solid rock at depths averaging 57.7 ft. below datum, or water level in the river. The construction conditions were very similar on both sides of the channel.

For the ten piers at the west side, after passing through the old filled ground at the top, there was ordinary soft blue clay to 41 ft. below datum, at which point air spades and picks were required for the stiff clay. For the east side, this depth was 42 ft. This clay continued to rock. Practically no water was encountered.

*Substructure Construction* —The substructure for the east leaf is located in the old riverbed, between the dock wall and the swing bridge (see Fig. 3). It was built without interruption of street traffic, excepting short intervals necessary for driving the east wall of the cofferdam under the west end of the swing span. The timber viaduct was supported over the cofferdam by means of girders and beams, and the supporting piles were cut off as the work required. As the bottom of the counterweight pit is 10 to 15 ft. above the river bottom, the intervening space was filled with earth, retained laterally by sheeting and topped with heavy timbering to support the new concrete.

For the west leaf the substructure is located entirely inland, about 160 ft. west of the west dock wall, in a maze of railroad tracks. Several switch tracks were removed to clear the site of the masonry, but the main tracks of the Baltimore & Ohio Railroad, located close to the east face of the masonry and handling daily more than a hundred train movements to and from the passenger terminal, in addition to switching movements, were maintained without interruption. A lead track of the Pennsylvania Railroad at the west side was interrupted only a short time for the diversion of a large sewer. All the sheeting necessary was driven under the viaduct, which afforded a headroom of about 20 ft. above the ground and caused no interruption of street traffic.

*New Bascule Bridge*—To carry Roosevelt Road across the new river channel a double-leaf bascule bridge has been built (see Fig. 1), 204 ft. c. to c. of trunnion bearings, with a clear span of 170 ft. between masonry piers and a total width of 90 ft. Its typical design is shown in Fig. 5. Each leaf has two deck trusses spaced 60 ft. c. to c. and covered by the 17-ft. sidewalks. The roadway, 56 ft. between curbs, is divided by a narrow refuge island on which are the poles for the double-track electric railway. With the high level of the deck, the curved bottom chords of the trusses afford a headroom for navigation of 24½ ft. for a width of 45 ft. and 16½ ft. for a width of 153 ft. The angle of opening is approximately 78 deg. Each leaf will weigh about 2,010 tons, with 1,220 tons of concrete counterweight at the heels of the trusses. The bridge is designed for a live load of 50-ton street cars on each track, 125 lb. per square foot on the remainder of roadway, and 100 lb. per square foot for the sidewalks. Impact is based on the formula $100 \div nL + 300$, where $L$ is the loaded length and $n$ is the number of 10-ft. traffic lanes loaded to produce the maximum effect.

The bascule trusses are about 21 ft. deep at the trunnions and 8 ft. at the outer ends, and their panels are

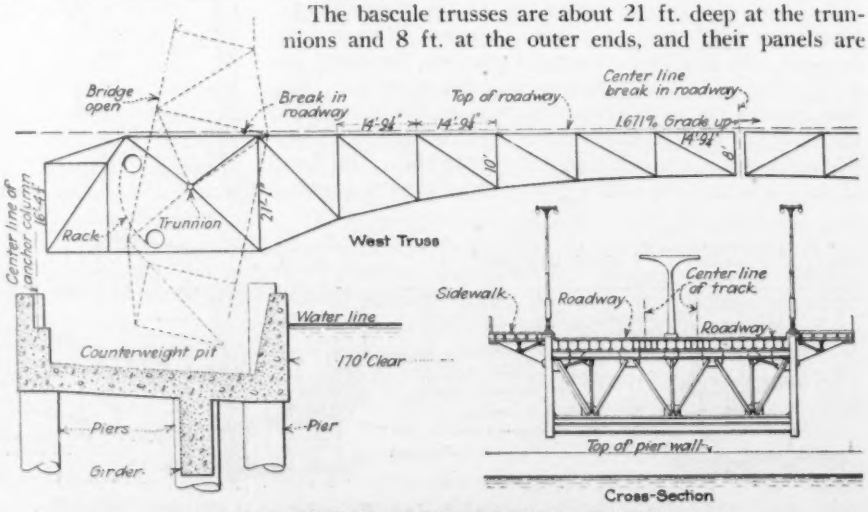



FIG. 5—GENERAL DESIGN OF BASCULE SPAN

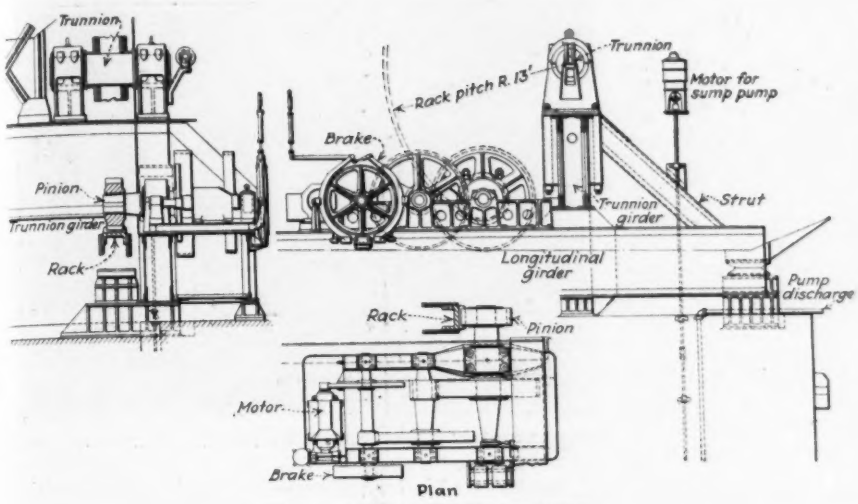



FIG. 6—OPERATING MACHINERY

about 14 ft. 9¼ in. long. Floor beams framed between the truss posts carry 26 lines of stringers, with two closely spaced stringers under each rail of the car tracks. The floor will consist of 6x12-in. creosoted sub-planking laid transversely, with 2-in. creosoted planking laid longitudinally and covered with 2x8-in. asphalt plank laid diagonally in herringbone pattern. The use of asphalt in this form as the wearing surface is a novel feature of the bridge. The 9-in. street-car rails are supported on cast-steel chairs spaced 2 ft. c. to c. and riveted between double stringers beneath each rail. These stringers also support the sub-planking. The entire bridge has an ascending grade eastward, 1.67 per cent on the west leaf and 0.714 per cent on the east leaf.

This bridge is of the trunnion bascule type developed some years ago for the city's river bridges. The trunnions, 24 in. in diameter and 8 ft. 7 in. long, are carried in cast-steel bearings mounted on a box girder which spans the tail pit transversely and is supported on steel columns on the foundation piers. Longitudinal girders are framed against the heads of these columns, and the trunnion girder is braced by diagonal struts to the river ends of the longitudinal girders. The plan of supporting the trunnions on a cross-girder is patented by the Strauss Engineering Corporation, Chicago, and the city is licensed to use it on this bridge.

Operation is effected by means of curved racks in the heels of the trusses, each engaged by a main pinion driven from a 75-hp. motor through a train of gears, as shown in Fig. 6.

*Erection of Bascule Span*—The bascule leaves were erected in the open position and with little interruption or inconvenience to street traffic. For each leaf of the bridge a large stiff-leg derrick was erected on a timber tower spanning the street, as shown by Fig. 7. These derricks were of 50 tons capacity, with 38-ft. masts; the length of boom was 80 ft. for heavy loads, which approximated 50 tons, and the maximum length of boom used was 120 ft., with approximate loads of 20 tons. The derricks were set on three-column towers which were built of three 15-in. I-beams, the longest of which was 45 ft. This raised the derrick sills above the street-car trolley wires and kept the street open for traffic while the bridge was being erected.

Heavy members were unloaded from cars with a locomotive crane near the bridge, and then reloaded on special standard-gage railroad trucks with bolster timbers and moved under the viaduct on temporary tracks. A trunnion girder being handled in the way is shown in Fig. 8. Holes and slots were cut in the viaduct floor so the bridge members could be hoisted into position with the derricks. The hoisting engines were placed on the ground, below the viaduct, and the cables were brought down along the columns, whence they were led to the engine, special blocks being built for this purpose. The swinging of the boom was done by a bull-wheel, connection being made to a special swinger engine placed alongside the hoisting engine. In Fig. 9 is shown the placing of the heel of one truss, with its trunnion seated in the bearings.

Surplus viaduct area on the north side was removed, so that the north trusses could be erected in clear space. But the south trusses were built vertically through slots cut in the deck of the viaduct, that for the southeast truss requiring relocation of the eastbound street-car track for some distance on the viaduct and swing bridge. Parts of the floor system are temporarily omitted, leaving sufficient headroom for street cars and vehicles to pass through the new structure. The south sidewalk of the bridge is also omitted temporarily.

*Other Erection Work*—The temporary viaduct over the site of the new channel is to be widened about 4 ft. on the south, and when the time arrives for placing the bridge deck, that part of the viaduct north of the south truss will be removed, leaving sufficient width to carry two lanes of vehicle traffic and a sidewalk, street-car service being necessarily interrupted for a short period.

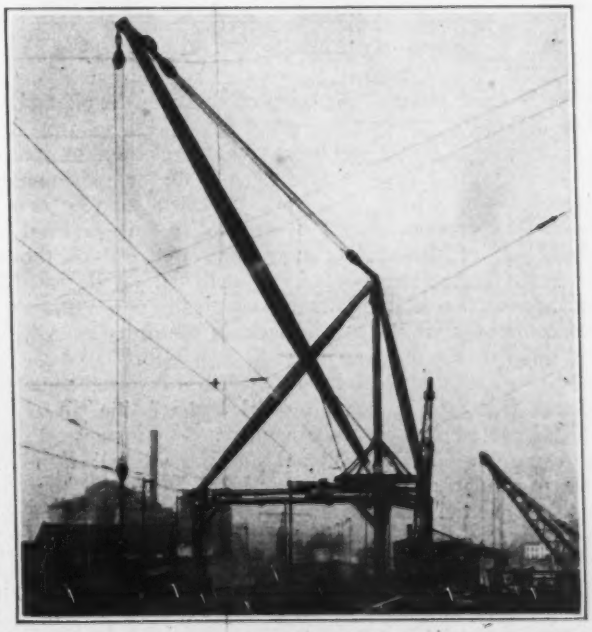


FIG. 7—ERECTION DERRICK MOUNTED ABOVE STREET

The floor systems will be completed at this time, except for the south sidewalk.

The west leaf will have its final roadway, but the east leaf will have a false deck, rising from the new bridge grade to meet the higher grade of the swing bridge and carrying the eastbound street-car track, with temporary rails, across the south truss of the new bridge, so as to clear the center truss of the old bridge. When this is completed, full street traffic will be restored, the remaining viaduct removed and the south sidewalk added. The interfering railroad tracks will meanwhile be moved to a position east of the center of the bridge, where they will have sufficient headroom and clearance with both leaves lowered.

This west leaf will be operated to permit the passage of dredges excavating the new river channel, the width of which will be temporarily restricted at this point. The east leaf, with its false deck, will remain stationary for some time. When the new channel is open for navigation, the north half of a new permanent approach viaduct will be built across the old channel, which will mean-

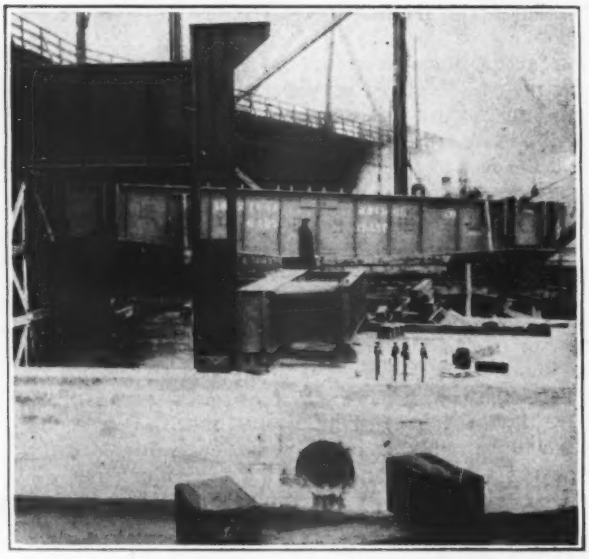


FIG. 8—TRUNNION GIRDER MOUNTED ON TRUCKS

while be filled, street traffic being carried over the old and new bridges.

The railroad tracks will meanwhile be relocated on the filled site of the present channel, and the new channel opened to full width. The false deck will then be removed and street traffic will be diverted to the completed north half of the viaduct approach. Removal of the swing bridge, construction of the south half of the viaduct, connection of the lateral ramp to the new viaduct and completion of the bridge deck, in the order named, will complete the program.

The various steps here briefly described involved some difficult feats of shoring, falsework and erection, all of which have worked out satisfactorily. For instance, to overcome the difficulty of landing large structural members, particularly the trunnion girders, weighing 85 tons each, under the viaduct, switch tracks were built on trestles across each tail pit, so that the members could be delivered on flat cars direct to position. In spite of the difficulties the bridge is being built in record-breaking time and will be ready for traffic barely a year after the work was started.

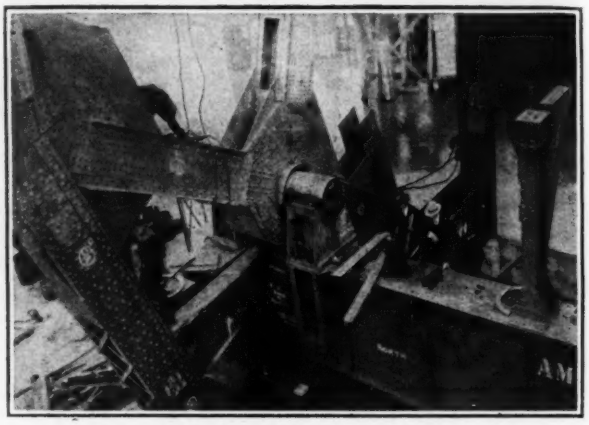


FIG. 9—TRUNNION PLACED IN ITS BEARINGS

*Engineers and Contractors*—The steel work for this bridge was fabricated by the American Bridge Company and erected by the Ketler-Elliott Company. For the substructure, the west pier was built by the M. E. White Company and the east pier by the Fitzsimons & Connell Dredge & Dock Company. All the work is under the direction of Paul Schioler, city bridge engineer, and Loran D. Gayton, city engineer. The bridge was designed in the department of public works under the direction of Donald N. Becker, engineer of bridge design, Thomas G. Pihlfeldt, engineer of bridges (now consulting engineer), and the late John Ericson, then city engineer. Its construction is in charge of Clarence S. Rowe, engineer of bridge construction, with Carl O. Johnson as resident engineer.

# Weld Efficiency in Penstock Pipe Using Overlap Welds

## Average of Many Tests Shows Welds Exceeding 90 Per Cent of Plate Strength for Plate Thicknesses of 0.4 to 1.3 In.

By Oren Reed

*Assistant Designing Engineer, San Joaquin Light & Power Corporation, Fresno, Calif.*

A SERIES of tests to determine the strength of overlap welds as used in the manufacture of penstock pipe was made by the writer in 1926, while factory inspector for the Balch penstock, which was then being manufactured by the Ferrum Company in Poland. The results of tests made at that time in addition to some made later by the same company on other penstock orders gave specific data on actual tests of 522 welded pipe sections. These data constitute the basis for the accompanying curves showing weld efficiency and ultimate weld strength. This information is supplementary to two articles on European penstock practice published in *Engineering News-Record*, May 5, 1927, p. 718, and May 12, 1927, p. 773.

Steel plate for fabrication into penstock pipe is tested at the steel mills, two tension and two bending tests being required on plate made from each open-hearth charge. The average tensile strength of 239 plate tests made by the writer was 51,550 lb. per sq.in., the range being from 48,000 to 58,200. The yield point was 65 to 75 per cent of the ultimate strength.

At the welding shops, by way of preparation for the longitudinal seams, the plates are bent completely around until the square cut edges overlap to the required extent and the proper diameter of the pipe is obtained. The surfaces to be welded are then carefully cleaned to prevent the inclusion of mill scale and the rough tube is taken to the welding machine. Here a short section of the overlapped edges is heated to a welding temperature by watergas burners placed opposite, one inside and one outside the pipe. After being raised to the proper temperature, the heated portion of the weld is hammer-forged on an anvil supported by a long counterbalanced beam.

During the welding process every endeavor is made to prevent oxidation, which would reduce and injure the metal. After a weld has been completed, a contiguous portion is heated and the hammer-forging process is repeated. When the entire length of the seam has been welded, the pipe section is heated in an annealing furnace to remove any strains that may have been set up in the vicinity of the seam by welding heat. This welding process is well controlled, but a great deal depends upon the skill of the operators.

Plate for a certain number of pipe sections is ordered in extra lengths so as to allow a ring approximately 6 in. wide to be cut from one end of the test section after the pipe is welded. The test sections are sufficient in number to give an average for the whole pipe line.

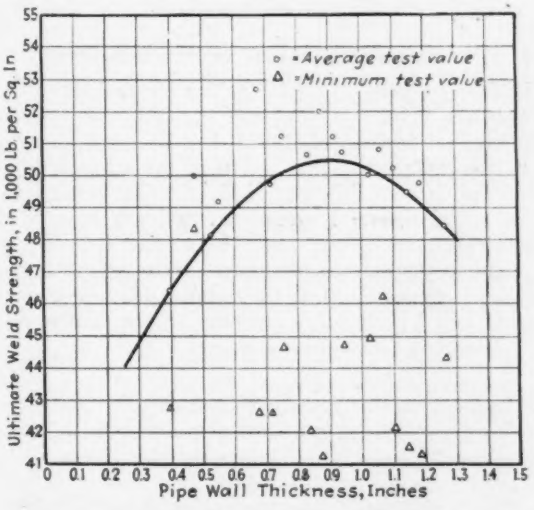



FIG. 1—VARIATION OF WELD STRENGTH WITH PLATE THICKNESS
Results of 522 tests on overlap welded penstock pipe.

From each of the test rings two pieces for the tension tests are cut from across the two welds and one or more pieces from the full plate. These are then flattened out and machined to obtain a test length of about 10 in. between the shoulders and 200 mm. (7.88 in.) between gage marks. The cross-section, especially for the weld pieces, is left as large as possible to get a representative result. Since the thickness of the plate is not reduced, the width of the test piece should be reduced only well within the capacity of the testing machine and never less than the thickness of the plate.

The variation of weld strength with plate thickness is shown by Fig. 1. A plate $\frac{3}{8}$ to $1\frac{1}{8}$ in. in thickness will give the most consistently good welds. No data were obtained for weld strength of plate less than 10 mm. (0.39 in.) or more than 32 mm. (1.26 in.) in thickness. Although a number of penstocks have been installed with a minimum thickness of $\frac{1}{4}$ in., a minimum thickness of about $\frac{3}{8}$ in. is common practice. A reasonable minimum thickness is required to give sufficient stiffness for transportation and in service.

The relation of average weld strength to the average full-plate strength is shown in Fig. 2. A plate strength of 52,000 lb. per sq.in. has been used. This is slightly below the average value determined by the writer but is approximately the guaranteed value. In designing many penstocks it has been assumed that a weld of 90 per cent efficiency would be always obtained. In general

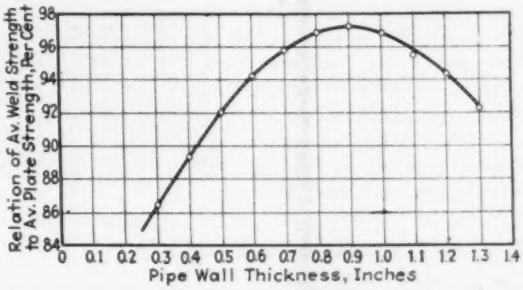



FIG. 2—WELD EFFICIENCY OF OVERLAP WELDED PENSTOCK PIPE
Using results of 522 tests with assumed plate strength of 52,000 lb. per sq.in.

this is conservative, but for thin plate (less than $\frac{7}{16}$ or $\frac{1}{2}$ in.) a lower efficiency should be used. When a thin plate is being welded, the metal may be burned and reduced in strength unless the welding operators are alert and experienced. A slightly lower efficiency for the thin plate would not add greatly to the total weight.

It has generally been assumed that plate thicker than about $1\frac{1}{8}$ in. should not be specified for penstocks. A heavy plate is difficult to heat to an even welding heat, which is necessary to produce a uniform weld. Fig. 2 would indicate that a maximum thickness of $1\frac{1}{4}$ in. (or slightly greater) can be used conservatively. This has led to the common European standard of using plain lap-welded pipe up to a plate thickness of $1\frac{1}{4}$ in. and specifying reinforced pipe for greater heads. For banded reinforced pipe, the plate thickness of the lap-welded core can be kept within limits which will insure good welds.

Minimum values of weld strength showed no definite trend. The minimum test value obtained was 41,200 lb. per sq.in., which represents a weld efficiency of approximately 80 per cent. A few low results are to be expected in any series of tests but should not be given too much weight. The test pieces are cut from the end of the pipe section, and therefore represent the poorest welds in the pipe. After the pipe is in service the ends are more or less strengthened by the joint. Usually the width of the test piece is small and minor defects affect

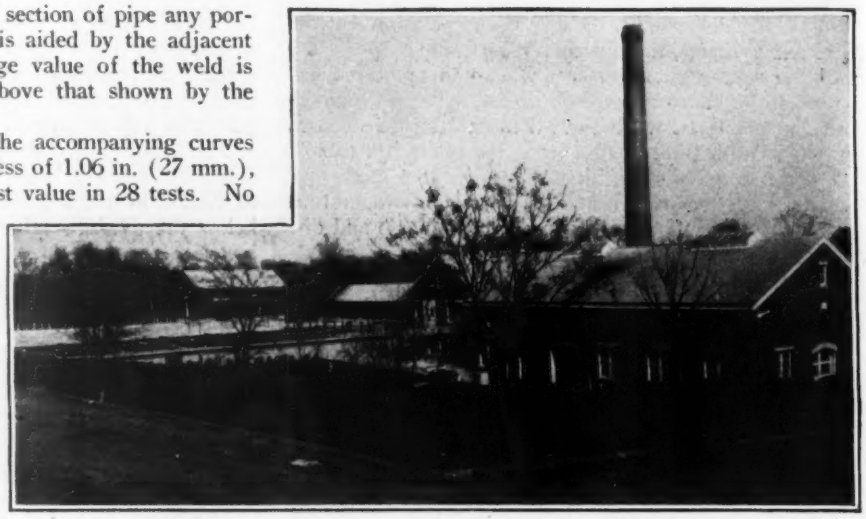
AVERAGE PLATE STRENGTH FOUND IN TESTS

| Plate Thickness (In.) | No. of Tests | Average Tensile Strength (Lb. Per Sq. In.) | Plate Thickness (In.) | No. of Tests | Average Tensile Strength (Lb. Per Sq. In.) |
|---|---|---|---|---|---|
| 0.39 | 5 | 46,380 | 0.91 | 1 | 51,200 |
| 0.43 | 1 | 54,300 | 0.94 | 42 | 50,700 |
| 0.47 | 7 | 49,985 | 1.02 | 32 | 49,970 |
| 0.51 | 2 | 48,100 | 1.06 | 28 | 50,820 |
| 0.55 | 2 | 49,150 | 1.10 | 10 | 50,230 |
| 0.67 | 21 | 52,650 | 1.14 | 70 | 49,460 |
| 0.71 | 34 | 49,720 | 1.18 | 123 | 49,760 |
| 0.75 | 45 | 51,220 | 1.26 | 7 | 48,410 |
| 0.83 | 59 | 50,580 | | | |
| 0.87 | 33 | 52,020 | Total | 522 | |

the results too much. In a full section of pipe any portion containing a small defect is aided by the adjacent metal and, although the average value of the weld is lowered, its strength is well above that shown by the small test specimen.

In plotting these values in the accompanying curves the minimum for a plate thickness of 1.06 in. (27 mm.), for example, was the lowest test value in 28 tests. No minimum value was put in where only one or two tests had been made for a particular plate thickness. The absolute minimum of all of the 522 tests that were made was 41,200 lb. per sq.in.

The curves are least well defined in the thinner plates; however, the relative values for the full range are well supported by the experience of workmen and engineers of the Ferrum plant.



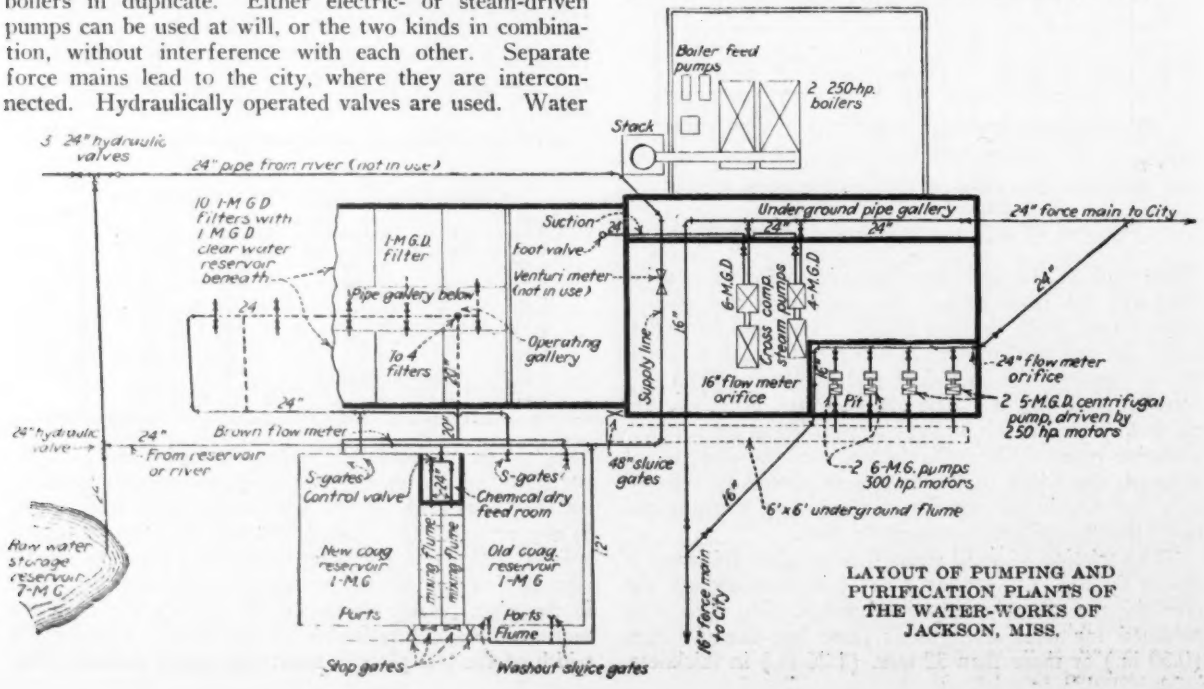
WATER-WORKS PUMPING STATION AT JACKSON, MISS.
Projecting toward the front at the left are the old and the new coagulation basins with the mixing flumes between.

## Filter and Pump Layout for Jackson Water-Works

By J. H. Ferrell
*Superintendent of Water Works, Jackson, Miss.*

COMPACTNESS, duplication, flexibility, reliability and complete operating control are features of the purification and pumping plants of the water-works of Jackson, Miss., shown by the accompanying layout plan. Water passes from Pearl River either to a raw-water reservoir or directly to mixing flumes and coagulation basins, both of which are in duplicate and can be operated separately, in series or in parallel. The dry-feed chemical machines are also in duplicate.

Electric-driven centrifugal pumps are the main reliance, with duplicate power lines and substation transformers. There is a stand-by steam pumping plant, with boilers in duplicate. Either electric- or steam-driven pumps can be used at will, or the two kinds in combination, without interference with each other. Separate force mains lead to the city, where they are interconnected. Hydraulically operated valves are used. Water entering the coagulation basins is measured by electric flow meters; there is a Venturi rate-control meter on the filter-supply line; flow meters indicate the rate of flow and the quantity of water passing to the city.




LAYOUT OF PUMPING AND PURIFICATION PLANTS OF THE WATER-WORKS OF JACKSON, MISS.

### No Extras for Mains in Paved Streets

In fixing a price of $100,000 for the property of the Tillsonburg (Ont.) Waterworks Company the valuation engineers on both sides agreed that no extra allowance should be made for paving laid after the mains had been put in the streets. Arbitration proceedings were brought to an end by mutual agreement, and purchase at the price already named was ratified by popular vote on Sept. 10. The works was one of the few under private ownership in Toronto—in fact, throughout the Dominion of Canada. E. V. Tillson is treasurer of the company.

# Civil Engineers Study Irrigation and High Dams

## Two Major Problems of West Outstanding Topics of San Diego Meeting of American Society of Civil Engineers—Notable Addresses on Civil and Naval Aviation—Roads and Sewage-Treatment Problems

MOST of the prominent civil engineers and constructors west of the Rockies gathered at San Diego last week at the quarterly meeting of the American Society of Civil Engineers. Since the program also was centered on problems of the West, the meeting had a clear regional aspect and thus emphasized a trend already recognized by the board of direction in its plans, as briefly noted in last week's news columns, for future development of the regional influence upon the society's spring and fall meetings. The attendance was unexpectedly large, going well toward 500.

Quite naturally, in view of San Diego's position as main Pacific Coast center of naval aviation, the subject of flying and flying fields occupied the general session. The city planning division also occupied itself with airport papers. The technical proceedings—which now appear to be mainly left to the technical divisions—were distinguished by two matters of great current importance: practice in design and construction of high masonry dams, and our national irrigation policy. In both subjects the meeting made contributions of lasting importance. Somewhat more usual was the sanitary engineering division's program, as much of it centered on activated-sludge sewage treatment; however, there was also a paper on pioneer work in the study of sewage distribution around marine outfalls. The highway division had two papers, one on treated gravel roads, the other on city paving administration.

The auxiliary features of the meeting were in themselves strong and individual. Rear Admiral J. M. Reeves addressed the society at the opening session on "The Eyes of the Fleet," and later, at a dinner, on "The Battle of Jutland," on both occasions with powerful appeal. The airchaft carrier "Langley" and its operation were described by Commander Moulton, of that vessel. Through the efficient co-operation of the southern California members, the naval officials and the famous weather of the region, visits to the North Island naval air station and to the aircraft carrier "Saratoga" contributed much enjoyment and instruction.

### Construction of High Dams

Present-day widespread interest in high dams found expression in three important papers, by A. J. Wiley, of Boise, on "Past Experience and Outlook for the Future"; by D. C. Henny, of Portland, on "Various Types of High Dams"; and by Prof. F. L. Ransome, of Pasadena, on "Foundation and Location Requirements of High Dams From the Viewpoint of the Geologist." The breadth of experience and the standing of the authors contributed to make these papers the outstanding feature of the technical proceedings.

While any detailed statement of the contents of these papers must be referred to abstracts of them which we hope to publish in an early issue, it should be said here that Messrs. Wiley and Henny pronounced themselves quite definitely on many questions which heretofore have been subject to much erratic variation of practice, disagreement of view among engineers, or even neglect. They outlined the field of different dam types, and in laying down the fundamentals of best present practice in dams they cited many observations based on long experience in dam building and service. Prof. Ransome's analysis of geological facts and conditions was of unusual value in interpreting for the engineer matters of rock formation essential to sound judgment of their suitability for dam foundations.

These papers, while concerned with the strength of structures, were presented at a joint meeting of the irrigation and construction divisions. Perhaps because of this mingling of two purposes and resulting shortage of time, there was striking lack of discussion, despite the great interest of the subject, the number of experienced dam builders present and the evident interest as shown by the earlier lobby discussions. Mr. Henny in a brief discussion urged that fuller study be given to cracks in mass concrete (such as are due in part to shrinkage), which may reduce the effective width of the base and otherwise diminish the resisting strength of the dam. Fred A. Noetzli, of Los Angeles, remarked that while cracks have long been noted and to some extent studied in buttressed dams, it has remained for the St. Francis dam failure to reveal by the discoloration of fracture surfaces how extensively mass concrete may be fissured.

In the part of the session given over to the construction division the papers were one by Willard Chevalier on "Engineering Skill of the Modern Constructor" and an illustrated one on the methods used in building the Coolidge dam, by J. T. Tripp, construction superintendent.

### Irrigation Problems

By far the most active and searching discussion of arid-land irrigation problems held within the society for many years occurred in the irrigation session. The report of a divisional committee on national reclamation policy, after several years' work, laid a foundation for crystallizing engineering opinion on a great problem of economics and engineering concerned with water resources. Supplemented by two papers on economic features of reclamation and by vigorous interchange of views, it made the session noteworthy. Further distinction was given it by an address on Mexican and international water problems.

Gustavo P. Serrano, Mexican member of the international water commission, spoke on irrigation development in Mexico and on some of the domestic and international problems involved. Several irrigation projects now under construction will reach the point of colonization within the next three years and will make 300,000 to 400,000 acres available for cultivation. Since these works, unlike those of the United States reclamation, are to be paid for in full by the settlers, colonization will doubtless involve many difficulties, which it is hoped soon to solve. Mr. Serrano also spoke of the international questions arising in the Tia Juana region (where the Rodriguez dam now is being built) and on the Colorado and Rio Grande, and expressed his belief that the present international commission, with its serious purpose and able membership, will reach a satisfactory solution.

*A National Policy*—Some years of active discussion and conflict of opinion within the division's committee on national reclamation policy led first to divided opinion but finally brought agreement, the resulting report being presented at this meeting. After reviewing the history of development under the reclamation act of 1902 and its subsequent amendments and supplements with their progressive additional gratuities to land owners on the projects, the report concluded that the waiving of interest charges is unwise. It stated that present agricultural overproduction makes it undesirable to bring new areas under cultivation, except for commitments already made. The broadest of its sixteen conclusions states that "the conservation of the waters in the rivers and lakes of the country should be under public control" and that "the regulation of the flow of streams for the prevention of floods and for the best possible utilization of the waters should be undertaken by the states, or jointly by the United States and the states."

J. B. Lippincott, of Los Angeles, chairman of the committee, presented the report with a full explanatory statement of his personal views, in which statement many data of the present condition of irrigation and federal reclamation were laid down. He expressed serious doubt whether projects now being built at costs of $150 to $200 per acre will ever be repaid, in view of the failure of many land owners on present projects to pay construction charges on projects costing only one-third as much. He mentioned also (1) the increase in the efficiency of water use and (2) the general raising of agricultural production per acre through better seed and improved cultivation as reasons against need for more farm area in the early future.

Dr. Elwood Mead, U. S. Commissioner of Reclamation, in "Some Economic Aspects of Federal Reclamation" strongly urged that settlement, preparation and land financing are vital elements of successful reclamation of arid lands. If aid in the preparation of land for irrigation and the improvement of farms is to be rejected as unwise paternalism, he said, "then the building of irrigation works to water unimproved land should cease, because to build them without knowing when and how the water will be used is plain business folly." He added that the methods proposed in the committee report for bringing about settlement are wholly inadequate.

C. E. Grunsky, of San Francisco, a member of the committee, in a separate paper developed at some length the view that stream regulation is the first and broadest community function with respect to water resources, especially for irrigation use. In the case of interstate and navigable streams the working out of plans for this regulation and control should be national. He opposed any settlement work by the United States, holding this to be the function of states or local communities.

Discussion was abruptly turned toward the Boulder dam project by Prof. G. E. P. Smith, of Tucson, with a discussion of the legal basis of reclamation, which led him to the conclusion that the federal government has no power over water resources. He asserted that friends of the Imperial Valley should work for the defeat of the Swing-Johnson bill, because the passage of this bill would be sure to tie the project up indefinitely in litigation.

M. J. Dowd, chief engineer of the Imperial Irrigation District, opposed the committee's conclusion on overproduction, and spoke of the need of the West for further development, of the growth of irrigation outside our borders and of the harmful effect of the committee's statement on the status of irrigation-district bonds.

George W. Fuller, of New York, brought up the question of national population increase, and held that there has been a marked slowing up of growth in the continental United States, which in conjunction with the present inefficiency of irrigated agriculture on many projects constitutes a reason against additional fostered reclamation.

Prof. Frank Adams, of Berkeley, expressed agreement with most of the committee's conclusions but held that the one conclusion which opposes federal aid to settlers looks backward and should not be supported, since the facts prove that aid to settlers is basic to the solvency of the entire work of reclamation.

M. C. Hinderlider, state engineer of Colorado, in a telegram stated that he strongly indorsed continued federal reclamation, with state control of all water resources, including return flow.

When the session came to considering action on the report, a motion to adopt and a motion to table succeeded each other. Finally it was voted to defer balloting on the report until the end of the (written) discussion. A further vote directed that the sixteen individual conclusions be balloted on separately.

### Air Transport and Terminals

Half a dozen papers on different phases of air and rail-air transportation and terminals emphasized in various ways the significance of recent progress in this new industry. The advanced stage reached by air service in point of safety and dependability, for example, was emphasized by statements that many insurance companies make no extra charge for covering their policy holders on air travel in craft operating on regular routes under federal license.

*Fields and Airports*—Discussion of the minimum size of safe landing fields brought out the opinion that for commercial uses the minimum requirement is for two 500x1,800-ft. runways intersecting at an angle of not less than 60 deg. Because time saving is the prime advantage of air transportation, airports remote from population centers are at a serious disadvantage and it is important to supplement them with landing fields closer in, even though these must be small.

Dr. Ford A. Carpenter, of Los Angeles, dealt with "Weather and Its Effect on Air Transport." Airports were discussed by George D. Burr, city traffic engineer of San Francisco, in "Landing Fields." Commercial transport service was treated by S. H. Noyes, Pennsylvania Railroad, Philadelphia, in "Co-ordination of Rail-Air Transportation." Two further papers on airports were by Assistant Secretary William P. MacCracken, Jr., of the U. S. Department of Commerce, on "Airport Ownership," and Donald M. Baker, of Los Angeles, on "Requirements of a Municipal Airport." Mr. MacCracken argued that airports should be owned and controlled by municipalities. In view of the scarcity of good field sites he compared the private control of air terminals to allowing a single steamer line to control an entire waterfront or harbor. Pending further development of air facilities, the airport investment might be likened to expenditures for parks, sewer systems and other improvements whose advantages cannot be expressed in terms of profit.

Mr. Baker discussed airport terminals as distinguished from landing fields, and treated of facilities for departure and arrival of passengers, handling of baggage and other cargo, storage, repair and other facilities.

Discussion of these papers generally indorsed the authors' views and arguments. Mr. MacCracken's attitude toward airport ownership was supplemented by statements of Gordon Whitnall, of the Los Angeles planning commissioners, with the argument that air terminals should be permanent in location so that it might be possible to plan the necessary road and rail connections permanently. The importance of considering transportation time from the passenger's actual starting point to actual destination was brought out by Mr. Noyes, who said that rail facilities are an integral part of the necessary total transportation and should have due consideration.

### Sanitary Division

Five papers on activated-sludge plant operations dealt with the plants of Lodi, Pomona, Los Angeles County, Pasadena and a mountain park valley in California (Dunsmuir).

"Theory of Predetermining the Extent of a Sewage Field in Seawater," by A. M. Rawn and H. K. Palmer, of Los Angeles, described some interesting glass-tank and open-water experiments to determine the spread of sewage from submerged outlets, both single and multiple. It was found that the thickness of the surface field was about one-twelfth the depth of submergence of the outlet. Formulas were derived and curves plotted, with checks from observation on actual sewers where dilutions were measured.

### Highway Division

*Bituminous Road Treatment*—A discussion of bituminous treatment of roads built of fine crushed rock and gravel was presented by Thomas E. Stanton, Jr., materials and research engineer of the California Highway Commission. He dealt with methods of design and construction and told of the commercial supply of premixed materials in his state, the mixing done at the plant costing 13c. to 20c. per ton. J. S. Bright, of the U. S. Bureau of Public Roads, suggested that there is much room for future research in the field of these treated roads. C. L. McKesson, of Sacramento, emphasized the economic value of treated surfaces, reporting a reduction in maintenance costs from $1,000 to $1,500 per mile in the case of untreated roads to $50 to $300 per mile. W. W. Crosby, of Coronado, laid stress on the fact that well-compacted sub-bases are essential to good service. B. A. Acharya, of the Board of Public Works, Bombay, India, reviewed highway conditions in America, Europe and India and expressed the opinion that America is progressing more rapidly than Europe. Emulsified asphalt was discussed among others by N. H. Neff, of Santa Ana, who said that better results in surface treatment can be obtained with this material.

*City Paving*—Discussion of a paper by Julius Adler, of Philadelphia, on "Highway Problems in Relation to Cities" led to interesting remarks by E. E. East, chief engineer of the Automobile Club of Southern California, Los Angeles, who stressed the importance of segregating streetcar and motor-vehicle traffic.

# Progress on the Cascade Tunnel, Great Northern Railway

THE 7¾-mile Cascade tunnel of the Great Northern Railway has been advanced steadily, and up to Aug. 31, 1928, the main tunnel had been completed to full section for an aggregate length of about 7 miles and the concrete lining had been placed for 6 miles. The date originally scheduled for completion of the tunnel was Nov. 30, 1928.

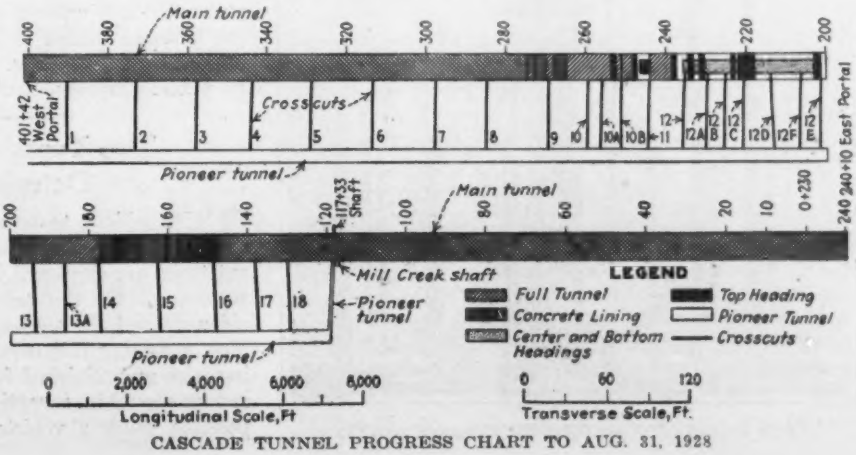
An unusual method of construction was adopted, for while a pioneer tunnel was driven parallel with the main tunnel, to permit of working the latter from several points, the pioneer tunnel extended only from the west portal to a shaft at Mill Creek, a distance of about 5¼ miles. This tunnel was driven 10,539 ft. from the shaft and 17,737 ft. from its west portal, the headings meeting on May 1, 1928, when a blast was fired by President Coolidge at Washington, D. C.

CASCADE TUNNEL: PROGRESS TO AUG. 31, 1928

| | Ft. |
|---|---|
| **Main Tunnel: Scenic, West End:** | |
| Center and top headings | 17,137 |
| Full section | 15,791 |
| Concreted | 13,278 |
| **Main Tunnel: Berne, East End:** | |
| Center and top headings | 23,520 |
| Full section | 21,185 |
| Concreted | 17,346 |
| **Pioneer Tunnel: Mill Creek to Scenic (completed)** | 28,276 |

Crosscuts from the pioneer tunnel enabled the main tunnel to be attacked from several intermediate headings, in addition to the portals. It also enabled the enlargement and concrete lining to proceed at numerous points. The progress up to Aug. 31, 1928, is summarized herewith in tabular form and is shown graphically on the accompanying plan. Descriptions of the tunneling conditions and methods were given in *Engineering News-Record* of April 14 and Aug. 11, 1927, pp. 626 and 224.

The Cascade tunnel, which will be part of a 24-mile electrified section of the railroad, is being built under the direction of J. R. W. Davis, chief engineer, Great Northern Railway, and is in direct charge of Frederick Mears, assistant chief engineer. The contract was let Nov. 25, 1925, to A. Guthrie & Company, Inc., of St. Paul, Minn., whose general superintendent on the work is W. E. Conroy. Work was started early in December, and the schedule provided for having the tunnel completed and ready for operation on Nov. 30, 1928.




CASCADE TUNNEL PROGRESS CHART TO AUG. 31, 1928

# From Job and Office

*Hints That Cut Cost and Time for the Contractor and Engineer*

## Erecting Water Tank of 1-M.G. Capacity

A WATER TANK of 1-m.g. capacity built recently for the city of Springfield, Ill., is 72 ft. in diameter with a cylindrical shell 17 ft. deep and elliptical bottom 23 ft. deep, the top of shell being 100 ft. above the footings. Twelve vertical posts support the tank. In the erection, the first step was to place the bottom ring of the 10-ft. riser pipe and install within it an air-operated derrick having an 87-ft. mast and 72-ft. boom. When the riser was completed to its 60-ft. height, the derrick hoisted itself to the top, from which position it handled the posts, bracing and tank plates, as shown in Figs. 1 and 2. The posts, of 14-in. H-beams, in two tiers of about 41 ft. each, were not guyed, being held merely by the anchor bolts until the bracing was placed. The inclined rods shown in Fig. 1 are the future horizontal radial rods from the riser to the tower posts.

This job was done in about three months by an erection gang averaging ten men, with A. S. Miller as foreman. On Jan. 11, in an eight-hour shift, the foreman with nine men placed thirteen of the bottom sections of the posts and 29 struts, making an average of 11.4 minutes for each piece handled. On Feb. 1, 2 and 3 a crew of twelve men besides the foreman assembled

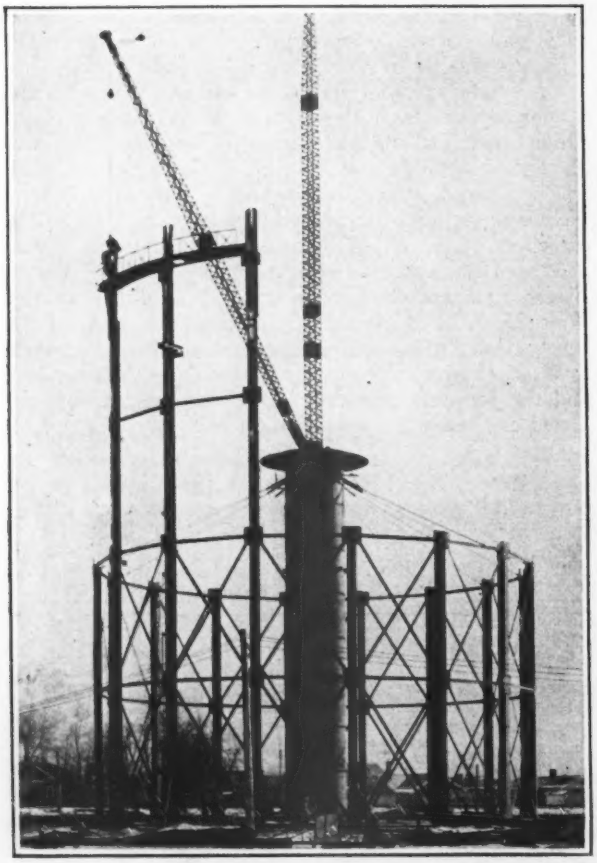


FIG. 1—SETTING SECOND SECTION OF TOWER

FIG. 2—TANK READY FOR ROOF

104 tons of steel, averaging ⅓ ton per man-hour. This included the upper sections of the posts, top struts, balcony section and first ring of shell plates, which had to be lifted an average height of 90 ft. It is stated that when the tank was filled for the first time there was not a single leak, so that there was no need for the usual water test and calking of leaks. The tank was built by the Chicago Bridge & Iron Works, under the direction of Willis J. Spaulding, commissioner of the department of public property, Springfield, Ill.

## Two Types of Railing Used on Detroit River Bridge

THE railings to be used on the Detroit River international bridge are unusual in that two wholly different types are employed in view of their having different functions. On the east side of the bridge there is no sidewalk and the steel-plate curb is 12 in. high. A vehicle mounting this curb will immediately meet the railing with undiminished force. This dictated that the east railing should be exceptionally sturdy. Also it should, if possible, guide a vehicle back into its path rather than

permit it to stick. The longitudinal members of the east railing, therefore, are ship channels set with the smooth surface exposed to the roadway. Only a 4-in. pipe above these channels and set away from them for protection recalls the opposite railing.

The west railing is protected by an 8-ft. sidewalk from receiving the full momentum of a vehicle. It is designed of fairly standard picket type with lighter horizontal channels. The vertical posts are rather more sturdy than usual and are surmounted by a 4-in. pipe with cast-iron connections. The west curb is made only 10 in. high as a compromise between the chance of a vehicle climbing it and the chance of a pedestrian suffering a severe fall if he should be jostled into the roadway.

## Quick-Hardening Cement Used in Winter Repairs to Reservoir

By Clarence E. Carter
*Assistant Engineer, Metcalf & Eddy, Consulting Engineers, Boston*

In repairing the Folly Hill reservoir of the Salem (Mass.) water supply it was necessary to undertake the work during freezing weather, and to restore the reservoir to service at the earliest date possible. This article describes the repair methods adopted, which included the use of a quick-hardening cement.

The reservoir, which was designed by the late W. S. Johnson, is 26 ft. deep and has a groined arch roof; the walls depend upon the aid of the passive pressure of the surrounding earth embankment to resist the water pressure. Apparently the embankment had settled slightly, which caused one wall to move outward at the top in order to regain the support of the earth. This movement caused a main crack at the junction of the walls, about 1½ in. wide at the top corner, and other secondary cracks radiating from this point. The impervious nature of the earth embankment was such that no serious results had followed the cracking. But since the exact extent and seriousness of the cracks could not be readily determined, it was thought advisable to make repairs at once in spite of the fact that this would mean working under winter conditions. The repairs consisted of tying the top corner of the walls together by a reinforced-concrete strap; bracing each wall near the corner with a reinforced-concrete buttress extending about 2 ft. beneath the floor of the reservoir into hard natural material; and filling all of the cracks with gunite.

As it was necessary to restore the reservoir to full service as soon as possible, a comparatively quick-hardening cement was desirable for all parts of the work. "Lumnite" and "Ferrocrete" cements were considered, and it was believed that satisfactory results would be obtained with either of them. "Ferrocrete" cement, which contains about 8.7 per cent of oxide of iron and alumina, was adopted, mainly on account of the fact that it requires no greater care in handling, placing and curing than is necessary with ordinary portland cement. It costs less than "Lumnite," and as it gains its full strength in four days as compared with one day for "Lumnite," work was not unduly delayed by its adoption.

The work was done by force-account contract, with temperatures ranging from 8 deg. during the night to 34 deg. during the day. The bulk of concrete was poured on a day when the temperature did not rise above 22 deg. F. Precautions were taken to keep the fresh concrete warm. Some of the buttress forms were removed after about eighteen hours and the concrete was found to be very hard, giving a good sound ring when struck by a hammer or heavy bar. The gunite hardened with sufficient rapidity to warrant allowing the water to rise over new work about twelve hours after completion of the repair. During the setting of the concrete considerable heat was developed and held, as was indicated by a surface temperature of 80 deg. F. on one portion when the forms were stripped 42 hours after placing the concrete. The cost of the work is shown in the accompanying table.

Frank P. Morse is city engineer of Salem. Metcalf & Eddy, consulting engineers, were asked to advise with regard to the necessary repairs, and were put in charge of the work with the writer as resident engineer. The Welch & Moynihan Company, of Salem, was the contractor.

COST OF REPAIRING SALEM, MASS., RESERVOIR

| Buttresses and Strap: | Labor | Material, Supplies and Equipment | Total | Unit Cost |
|---|---|---|---|---|
| Excavation and backfill (137 cu.yd.) | $2,962.00 | $746.98 | $3,708.98 | $27.08 cu.yd. |
| Concrete (88 cu.yd.) | 2,352.76 | 1,161.64 | 3,514.40 | 39.94 cu.yd. |
| Sub-total | $5,314.76 | $1,908.62 | $7,223.38 | *$82.08 cu.yd. |
| Repair of Cracks: | | | | |
| Excavation and preparation (473 lin.ft.) | $1,054.12 | $393.35 | $1,447.47 | $3.05 lin.ft. |
| Gunite in place | 127.43 | 550.50 | 677.93 | 1.44 lin.ft. |
| Sub-total | $1,181.55 | $943.85 | $2,125.40 | $4.49 lin.ft. |
| Total cost to contractor | $6,496.31 | $2,852.47 | $9,348.78 | ..... |
| Contractor's fee | ..... | ..... | 1,275.00 | ..... |
| Total cost to city (exclusive of engineering) | ..... | ..... | $10,623.78 | ..... |

* Based on quantity of concrete placed.

## Analysis of Various Types of Floor for the Detroit River Bridge

Several different types of floors were compared before final selection of the floor for the Detroit River bridge. The types of floors considered were: (1) Buckle plates with as much additional concrete as the dead-load assumption would permit; (2) a 7-in. concrete slab with rod reinforcement and with one additional line of stringers; (3) an 8-in. Haydite concrete slab, also with an additional line of stringers; (4) a 6-in. concrete slab with fabricated truss reinforcement of the same general type as used on the Philadelphia-Camden bridge, these trusses to be placed on 6-in. centers and the additional line of stringers being included. In all cases the weight and cost of a 2½-in. asphalt pavement were included.

Approximate calculations indicated that 1 lb. per square foot of floor represented a cost of $1,600 in cable wire and of $700 in tower steel, the former being fully realizable, as the number of wires could easily be accommodated to the stress, but the saving in tower steel being more problematical, because the column plates were already designed by the usual one-thirtieth rule and the angles could not be greatly modified.

The approximate cost per square foot of the various types of flooring was obtained by reference to Detroit contractors. Equations were then set up covering these costs and the effect of dead weight upon the cables and towers. The results of such a comparison could not be perfectly reliable, but they were in the direction of establishing the truth. They indicated that, with a difference of 30 per cent between the cost per square foot of the cheapest and most expensive slab, there was a difference

of only 4 per cent between the highest and lowest over-all cost. Although the buckle plate was indicated as cheapest, it undercut the concrete slab with fabricated reinforcement by so little that the latter was chosen by the contractor, the McClintic-Marshall Company, from a long-term maintenance standpoint.

## Determining Sewage Flow From Dosing Tank Discharge Intervals

By James L. Barron
*Assistant Engineer, Kansas State Board of Health*

THERE are many sewage-treatment plants with dosing chambers discharging to trickling filters which have neither devices for metering the sewage flow nor pump wells where the rate of rise may be measured by stop watch and hook gage. Such was the case at Emporia, Kan., where in the course of recent experiments in the chlorination of raw sewage it became necessary to determine the total daily flow and also the hourly variations. The following method of measurement was therefore devised, which is adaptable to any similar plant.

The total flow, as indicated by the number of dosing tank discharges, must be corrected for the flow entering the siphon chamber during the discharge periods. In the formula

$$1440R = CN + (S \times N \times R)$$

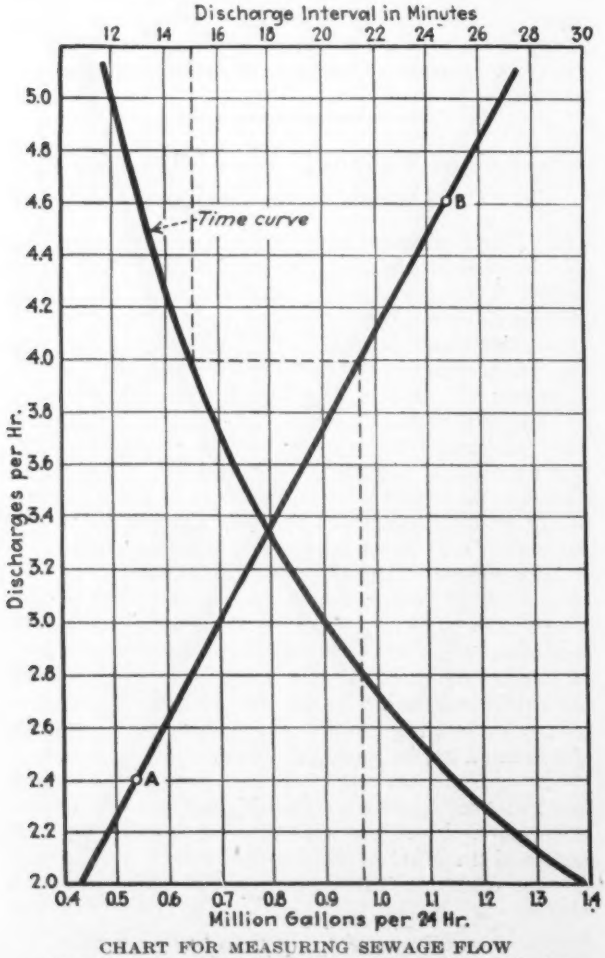



CHART FOR MEASURING SEWAGE FLOW

Example: Assume discharge interval as fifteen minutes. Enter as shown and drop down to time curve. Cross horizontally to curve *AB*, then down, reading rate of flow as 0.97 m.g. per 24 hours.

# From Job and Office

***Hints That Cut Cost and Time***

$R$ is the rate in gallons per minute, $S$ is the minutes of siphon discharge, $N$ is the total number of tank discharges per 24 hours and $C$ is the capacity of the dosing tank. $S$ is determined by stop-watch measurements of at least two siphon discharge periods, one during a low rate of flow and the other during a high flow. The siphon discharge intervals accompanying each period, $S$, determine the value of $N$. These values substituted in the formula fix two points on the straight line $AB$, as shown in the accompanying diagram. The time curve is then constructed between discharges per hour and the discharge intervals in minutes so that the simple observation of the interval between the breaking of one siphon flow and the next gives directly the rate of flow in million gallons per 24 hours.

By using a Veeder or similar counter to determine the number of tank discharges for 24 hours or a longer period, and reducing to discharges per hour, the total daily flow is also indicated directly. The accuracy of this method depends upon the proper measurement of the period during which the siphon is discharging with widely varying flows, and also on careful determinations of the draw-down capacity of the dosing chamber.

## Steamer Discharges Bulk Cement by Compressed Air

BULK cement delivered on the job by steamer is a novel feature in the concreting plant for the foundations of the Merchandise Mart, Chicago, which is to be the largest commercial building in the world. The site is at Wells and Kinzie Sts., with 578 ft. frontage on the north bank of the river. Cement is delivered by the Manitowoc Portland Cement Company in a steamer built for carrying bulk cement and having a capacity of about 4,000 bbl. An air-compressor plant provides for discharging this cargo through 5-in. pipes. A cement storage bin with a capacity of 5,300 bbl. has been built at the construction plant and the steamer discharges its 4,000-bbl. cargo in six to seven hours, the horizontal distance to the bin being about 125 ft. and the vertical height about 75 ft. The John Griffiths & Son Company, Chicago, has the contract for this foundation work.

## Protecting Freshly Painted Traffic Lines From Damage

A SIMPLE solution for the perplexing problem of how to prevent vehicles from driving over freshly painted traffic lines is described in *California Highways and Public Works*, the official organ of the California State Highway Commission. This scheme was developed in District 7 and has been very successful. Even with the use of fast-drying paint, it has been found that vehicles will run over the line and track it to other parts of the pavement. The placing of an occasional sign along the newly painted line helps, but it is not sufficient.

The California engineers prepared a number of simple signals, consisting of a piece of No. 8 iron wire bent into a loop, with a single strand about 6 in. long at right

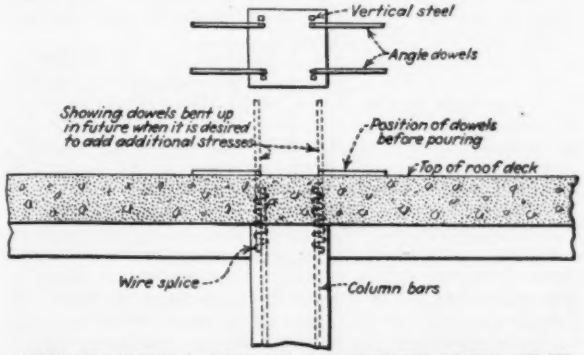
# From Job and Office

*For Contractor and Engineer*

angles to the plane of the loop. At the end of the 6-in. piece is a small kink or loop into which is tied a piece of bright red rag. The circle acts as a base, the rag as a signal. One man, who can easily carry 100 or more of these signals, walks behind the painting machine and places them at intervals of about 5 ft.

## Arranging Column Reinforcement for Extension

PROVISION for future increase of height of a reinforced-concrete building can be made by embedding angle shaped dowels in the top of the roof columns, instead of extending and bending down the main column reinforcement, according to J. N. Burford, of Indianapolis. The accompanying sketch shows the arrangement intended. The outstanding lengths of the bent dowels may be placed so that their tops are flush with the top of


Vertical steel
Angle dowels
Showing dowels bent up in future when it is desired to add additional stresses
Position of dowels before pouring
Top of roof deck
Wire splice
Column bars

ARRANGEMENT ALLOWING FOR FUTURE INCREASE IN HEIGHT OF REINFORCED-CONCRETE BUILDINGS

the roof slab. They must, of course, be covered by the roofing. When another story is to be added, it is necessary only to remove the roofing, chip out and bend up the dowels and wire the column extension steel to them. The lap of the dowels in both stories must of course be sufficient to develop bond; usually 30 diameters ought to be sufficient.

## Amount and Heat Content of Sludge Gas Determined From Curves

By G. A. Deatel

*Junior Civil Engineer, Bureau of Sewers, Baltimore, Md.*

THE engineer who may be planning sewage sludge digestion tanks where gas will be collected and used will find use for the accompanying curves, which facilitate the quick determination of the total gas evolved per day and also its heat value. The following notes indicate how the two curves are used. First, as to Fig. 1, on the assumption that the number of persons served is 55,000, that the quantity of gas evolved per capita is 0.8 cu.ft. and that the heat value of the gas is 400 B.t.u. per cubic foot, it is apparent that the total heat content of the gas is almost 18 million B.t.u. per day. An illustration of the use of Fig. 2 follows: On the assumption that the number of persons served is 55,000, the sewage flow per capita is 100 g.d., that the quantity of solids removed is at the rate of 200 p.p.m. and that the gas

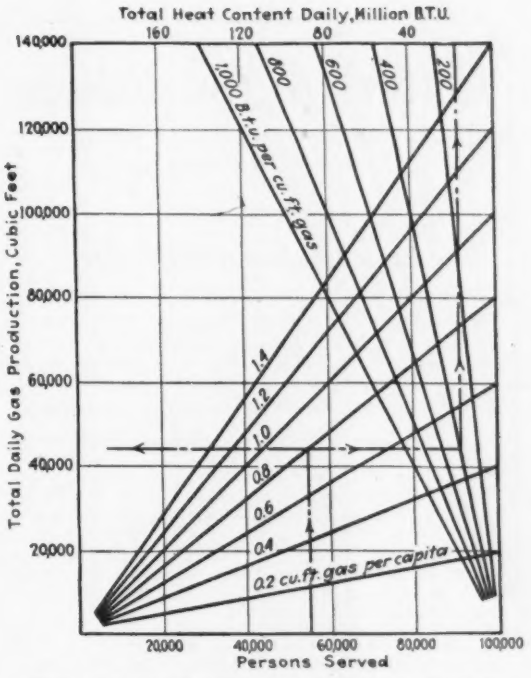



FIG. 1—DAILY HEAT PRODUCTION OF SLUDGE-DIGESTION TANKS

evolved per pound of dry solids is 6 cu.ft., it is apparent that the total daily gas production is approximately 55,000 cu.ft. per day. In case the population served is greater than that shown by the curves, a necessary constant can be readily applied to values given on these diagrams.

Acknowledgment is due to C. E. Keefer, engineer of sewage disposal, Bureau of Sewers, who made valuable suggestions in the preparation of these curves.

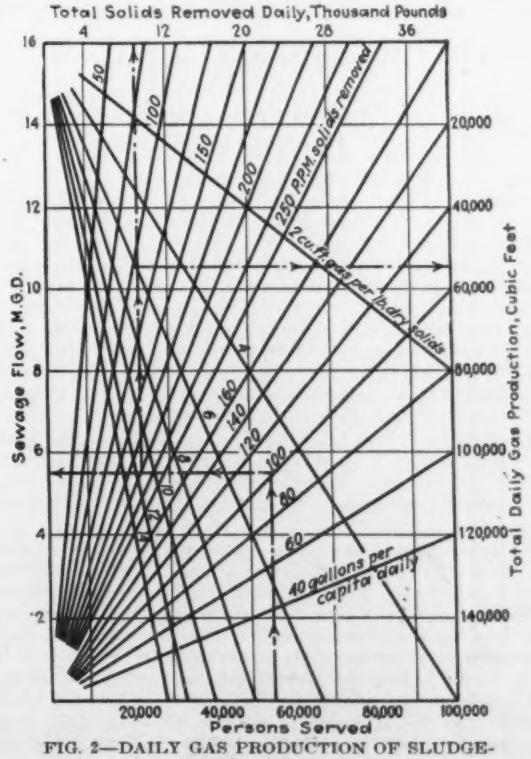



FIG. 2—DAILY GAS PRODUCTION OF SLUDGE-DIGESTION TANKS

# Letters to the Editor

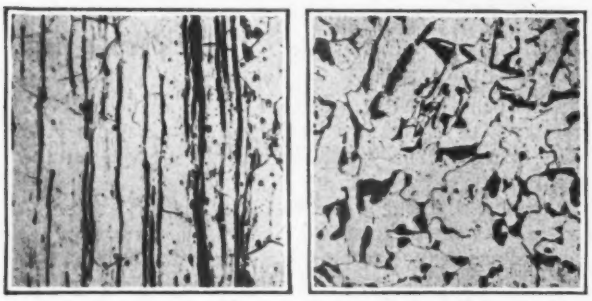
*A Forum for Discussion of Views of Engineers and Contractors*

## Old Wrought Iron Miscalled Steel

Sir—Please refer to your issue of April 12, 1928, pp. 589 and 590, and note the article headed in bold type "Long Service Tests of Thin Steel Show Varying Life—Steel Flumes, Pipes and Shells of Bridge Piers Examined After Long Service—One Pipe in Ground 58 Years." Below the heading the following comment is made by the editor:

> In the three notes following, all related to the life of thin steel plates or pipe in service, two report a very long period of service with the metal still in excellent condition, whereas the third, by contrast, is a case of short life due to corrosion. These three items are grouped to encourage comparison and conclusions. The most significant of the three is the case of the thin water pipe taken up 58 years after laying and found still worth reconditioning for further service. This instance puts great emphasis on the importance of securing a protective coating that is effective and durable.

After reading the articles beneath the comment, some of the statements made appeared incorrect and we made an



PHOTOMICROGRAPHS OF WROUGHT-IRON PIPE (LEFT) AND STEEL PIPE (RIGHT)

investigation of the actual condition and life shown by the materials in service.

In the comment made by the editor on the thin water pipe, no mention is made of the fact that this line was *wrought iron*, as mentioned in the article by George W. Pracy, engineer of distribution of the Spring Valley Water Company, San Francisco. Mr. Pracy stated in his article that the 30-in. riveted water main that had been in the ground 58 years was made from wrought-iron plate ¼ in. thick. This main, known as the San Andreas pipe line, was put in service in 1870, buried in a sandy yellow clay, working under a pressure of 55 lb. per sq.in. After cleaning up the 30-ft. sections of this pipe after 58 years' service, they were found to be in serviceable condition and in all probability most of them will be again put in service.

Upon request, Mr. Pracy kindly furnished us with sections of the plates cut from this pipe, and upon examination we found the iron to be in excellent condition. Judging from its present appearance, it should last at least another half-century.

Analysis made of one of the sections received by us shows the following compositions: Carbon, 0.029; manganese, 0.027; phosphorus, 0.177; sulphur, 0.029; silicon, 0.198; slag and oxide, 3.270 per cent. You will note that this wrought iron does not differ in composition from the genuine wrought iron made today by reputable manufacturers.

As to the article by Merrill Butler, engineer of bridges and structures, Bureau of Engineering, Los Angeles, headed in bold type "Steel Shells in Service 39 Years Still Sound and Serviceable," Mr. Butler kindly furnished us with samples cut from these shells. Upon analysis and microscopic examination we find the material to be genuine wrought iron and not steel. The samples examined by us were parts of the shell above and under ground and show the material to be in excellent condition after this long service and show no indication of any protective coating having been applied at any time. The iron is in as good condition as when it was put in place.

To show you the decided difference in structure between the two kinds of material we are inclosing herewith photomicrographs of the structure of both genuine wrought iron and steel. As shown by the photomicrograph, genuine wrought iron is a composite mixture of almost pure iron (the ferrite being the white portion shown) and bands of non-corroding siliceous slag rather uniformly distributed throughout the structure (the dark lines on the photograph). Steel does not in itself possess this slag, the light portion being ferrite and the dark portion carbide of iron.

C. T. RESSLER,
Research Engineer,
Reading Iron Company.

Reading, Pa.,
Sept. 10, 1928.

## Well Points for Lowering Groundwater

Sir—From time to time in recent years mention has been made in articles and in advertisements of *Engineering News-Record* of the use of a battery of well points for lowering the groundwater in the vicinity of deep excavation. Except in unusual soil probably by far the most common way of unwatering excavation has been by pumping from a sump within the excavation or trench.

One of the first instances of unwatering an excavation by wells driven outside of the excavation was in the construction of certain sections of the North Metropolitan Sewerage System in the vicinity of Boston, Mass., and was described by Howard A. Carson, then chief engineer of the Board of Metropolitan Sewerage Commissioners, in his reports of 1891 and 1892, which may be quoted as follows:

"The first masonry was laid early in August. When the excavation reached a point about 60 ft. from the beginning, a boiling spring made its appearance in the bottom. The water from this spring carried with it a constant stream of very fine sand. The excavation and pumping were continued, and the quicksand flowed in from the sides of the trench, particularly from the north side, and soon made a decided settling in the surface of the street. Sand also flowed from underneath and from the side of the masonry sewer already in, settling and cracking it near the spring and disintegrating the ground in the vicinity. As soon as practicable, tongued and grooved sheet piling was driven both on the sides and across the advanced part of the trench to some depth below the lowest part of the excavation, so as to tend to confine the quicksand; and bents of round piles, with a timber platform, were arranged as a foundation for the sewer. The trench in the vicinity of the boiling spring was refilled, and will be opened later to a greater width, and the masonry which was cracked will be taken out and rebuilt."

"The difficulties with boiling quicksand, described in my report for last year, continued during the fall of 1891. On Nov. 4, after serious delay and expense, the contractor had a section of platform completed near Congress Ave., supported on capping and piles. Quicksand had covered the platform. For eight days the contractor's gang worked, endeavoring to remove the quicksand from the platform, but at the end of this time the depth on the platform was greater than when they began. The trench was almost filled with bracing, which from time to time had necessarily been put in, and was in a very demoralized condition. Borings revealed the fact that at a distance of 22 ft. below the bottom of the sewer there was a stratum of gravel containing water. The stratum was doubtless inclined and extended to more or less distant elevations. The water in the stratum was under pressure, and rose in an open-ended telltale pipe to within about 7 ft. of the surface of the street, or about 20 ft. above the bottom of the excavation. This water, seeking an outlet, came up through the very fine earth, causing boiling springs of quicksand.

"It was suggested to the contractor that the difficulty could perhaps be cured by sinking pipes into the gravel and lowering the head of water to a point below the excavation. The

contractor, however, disheartened by the great expense and trouble that he had already had, did not care to go to any further expense in trying an experiment. He had taken the work at a low price and prosecuted it with energy and perseverance. If he abandoned the contract, it would cause serious delay and loss to the state. If the experiment was successful, the method could be used to advantage at other points on the system. It was therefore recommended that pipes be sunk on that section at the expense of the state.

"The plan was approved by your board, and proved entirely successful. The wells were sunk about 8 ft. apart at first, and later at greater distance. When eight of these had been put in, they were capped and connected together, and also to a 6-in. Blake pump. Within 24 hours after pumping on these pipes began, the water in the trench which had leaked in from the sea was pumped out, and it was found that the boiling springs had entirely ceased. The quicksand which covered the platform alluded to above was removed without any difficulty whatever. This method was pursued . . . for a distance of 1,400 ft., and 50 wells were driven before the bottom could be exposed without danger of demoralization. For the whole length of this difficult work tongued and grooved sheet piling was driven on both sides of the trench, to secure its stability.

"No further trouble from boiling springs and quicksand has occurred on this section during the year, except once or twice when the experiment was tried of stopping pumping on the pipe wells. Similar difficulty with quicksand has occurred on various other parts of our work and has been successfully treated in a similar manner by the contractors."

If any reader of *Engineering News-Record* knows of the earlier use of similar methods for unwatering excavations it would be interesting to have them cited.

FRANCIS H. KINGSBURY,
Assistant Engineer,
Massachusetts Department of Public Health.

Boston, Mass.,
Sept. 20, 1928.

## *Condition of the Boyds Corners Dam*

Sir—With reference to reports on the Boyds Corners dam which appeared in *Engineering News-Record* of Aug. 2, p. 176, and Aug. 16, p. 250:

The stress analysis made by A. S. Burgess indicates that with reservoir full the masonry section of the dam must withstand considerable tension in the upstream face or it must fail. The dam has carried its load for 60 years, and to some engineers it may seem almost miraculous that a masonry dam with a slim cross-section, and with an earthfill above which is supposed to increase the load the masonry must carry, should stand even for 24 hours. God's laws are working perfectly at Boyds Corners, just as they work in all parts of the world. It is true that we humans can, under certain assumptions, prove that a dam should fail, and when it does not fail explain that it just stands for the "grace of God." Our mathematics may be 100 per cent perfect and our assumptions 1,000 per cent in error.

When an engineer designs and builds a dam, he should make certain that he has so designed the structure that it will safely resist every conceivable stress that the stored waters will bring to bear upon it. If there is a weak spot in a dam, the water will certainly find it. The competent designing engineer knows the weapons the water always has available, and designs his structure to meet every attack the pent-up waters may make.

At Boyds Corners dam the water began to attack the structure immediately on the filling of the reservoir (1) by permeating the earthfill; (2) once through the earthfill, by developing a pressure on the masonry wall; (3) by saturating the earthfill and thus bringing, in part, the weight of the earthfill to play upon the masonry wall.

In the writer's opinion the water would have succeeded in tearing out the dam had it not been for the fact that the masonry was not impervious. Enough water seeped through the masonry to relieve, to some extent, the pressure which developed between the earthfill and the masonry. After 30 years, however, these outlets must have become partly sealed and sufficient pressure developed to break the masonry wall. With the masonry broken, the water could escape and the pressure was immediately reduced. Judging from the pictures, the outlet through the masonry at the highest section is about 33 ft. below its crest. With the water pressure on the masonry starting at a point 30 ft. below the crest of the dam, the resultant pressure falls well within the middle third and the whole structure is safe.

I believe this explains why the dam did not fail completely. However, the drains may again become partly sealed and with the dam already weakened complete failure might follow. The precautions for safety recommended by Mr. Brush are wise, in the opinion of the writer.

The combination earth-masonry dam at Boyds Corners could have been made a safer structure had an adequate drainage system been installed in the masonry dam before the earth dam was built above it. Holes drilled through the masonry 30 ft. below the crest and 10 ft. apart would have prevented the water which seeped through the earthfill from developing a dangerous pressure on the masonry. However, this does not mean that if such a drainage system had been installed the writer would be satisfied with the Boyds Corners dam as designed and built.

E. C. LA RUE,
Consulting Engineer.

Los Angeles, Calif.,
Aug. 30, 1928.

## *Long Straight-Line Courses*

Sir—In your issue of Aug. 9 there appears a paragraph on p. 202 headed "Canadian Boundary Well Marked," in which you state: "An exact description of the boundaries includes a total of 10,310 straight-line courses, of which the largest is 647 miles. This is believed to be the longest straight-line course in any survey in the world."

The straight-line course referred to is evidently the Alaska-Yukon boundary. It may interest your readers to know that the Saskatchewan-Alberta boundary is considered by this survey (the Topographical Survey of Canada) to be the longest straight-line course in the world over which continuous measurements have been made. This boundary runs due north from the international boundary to the 60th parallel, a distance of 761 miles. The Topographical Survey of Canada has marked out and surveyed this line on the ground as far north as the south shore of Lake Athabaska, a total length of 695 miles, and over this length the line has been chained and check-chained, frequent astronomical observations for azimuth have been taken, monuments have been established every half-mile and spirit levels have been run.

The longest straight-line boundary in the world is the east boundary of western Australia, which is defined as the meridian of longitude 129 deg. east. It extends across the whole width of Australia, a distance of about 1,158 miles, but only a comparatively small part has as yet been marked on the ground.

F. H. PETERS,
Surveyor General.

Ottawa,
Sept. 20, 1928.

## *Reinforced Approach Slabs for Highway Bridges*

Sir—I have noted your editorial "A Road Improvement" and also an article by W. H. Rabe, "Reinforced Approach Slabs for Highway Bridges," in the issue of Sept. 6. I have used reinforced-concrete approach slabs on paved highways at the ends of bridges since 1923, and it has been my custom to provide paving brackets for such slabs on all bridges designed in my office since that time, whether the highway was scheduled for immediate pavement or not. The first highway project on which I adopted reinforced-concrete approach slabs for the bridges is the Fort Snelling-Mendota bridge and the connecting highways near Minneapolis. The Fort Snelling-Mendota bridge and also a small bridge on the connecting highway were designed in the last half of 1923. I prefer a wider bearing than 6 in. for the bridge end of the reinforced slab, and it is my practice to provide a bearing from 9 to 12 in. in width. The advisability of using such slabs was impressed upon me by noting the almost universal failures of pavements at the ends of highway bridges.

WALTER H. WHEELER,
Designing and Consulting Engineer.

Minneapolis, Minn.,
Sept. 22, 1928.

# News of the Week

## New York City Awards Rock Tunnel Contract Totaling $42,692,867

### Four Sections of Water Bore Grouped in One Contract—Work Requires About Six Years

CONSTRUCTION contracts for all four sections of the Catskill Water Supply system tunnel No. 2, New York City, has been awarded by the Board of Water Supply to Patrick McGovern, Inc., for a total of $42,692,867.50.

The route of the new tunnel is shown on the accompanying map. Low bids were received as follows: On contract 224, for the section between Hill View reservoir, Westchester, and Spencer Square, the Bronx, the Carleton Company submitted a low bid of $10,585,630. For contract 225, from the Bronx under the East River to a point near the south channel, the Del Balso Construction Corporation submitted a low bid of $10,629,889. For contracts 226 and 227, the section under Queens to a point near Newtown Creek, and the section under the creek and through Brooklyn to Hamilton Ave. and Hicks St., the low bidder was Patrick McGovern, Inc. For contract 226 the amount was $10,247,785 and for contract 227 it was $11,214,890. However, the McGovern bids were accompanied by an offer to deduct $225,000 on each contract if he should be awarded two, or $900,000 if awarded all four. This offer reduced the bid on the entire job from $44,492,567.50 to the amount of the final contract.

The tunnel will have a diameter of 17 ft. and will be constructed at depths ranging from 250 to 700 ft. below the surface. It is estimated that construction will take about six years. A full description of the project was given in *Engineering News-Record*, March 31, 1927, p. 523.

### Fast Progress on Canadian Railway Construction

The building of both the new Hudson Bay Railroad in Canada and its connecting line to the Flin Flon mine has proceeded rapidly during the past season. On the Hudson Bay Railway steel is being laid at the rate of about 1 mile a day. It is the intention of the engineers to continue work throughout the winter when weather conditions will permit, and it is expected that the road will be completed to within 20 miles of the Fort Churchill terminal by next April. Extensive grading operations are necessary from this point on, but it is believed that trains will be operated to Fort Churchill by next August.

The Manitoba & Northern Railway, extending from the Hudson Bay line to the Flin Flon mine, a distance of 85 miles, was completed by the driving of the last spike with formal ceremony on Sept. 22. This was three months before the time specified in the contract and earned for the contractors a bonus of $250,000. Early completion was of great importance, as it was necessary to transport 25,000 tons of material for the construction of a power plant at Island Falls from Flin Flon to the site of the plant by a winter road 65 miles in length. The initial development at the new plant will be about 36,000 hp., and it will cost $7,000,000.

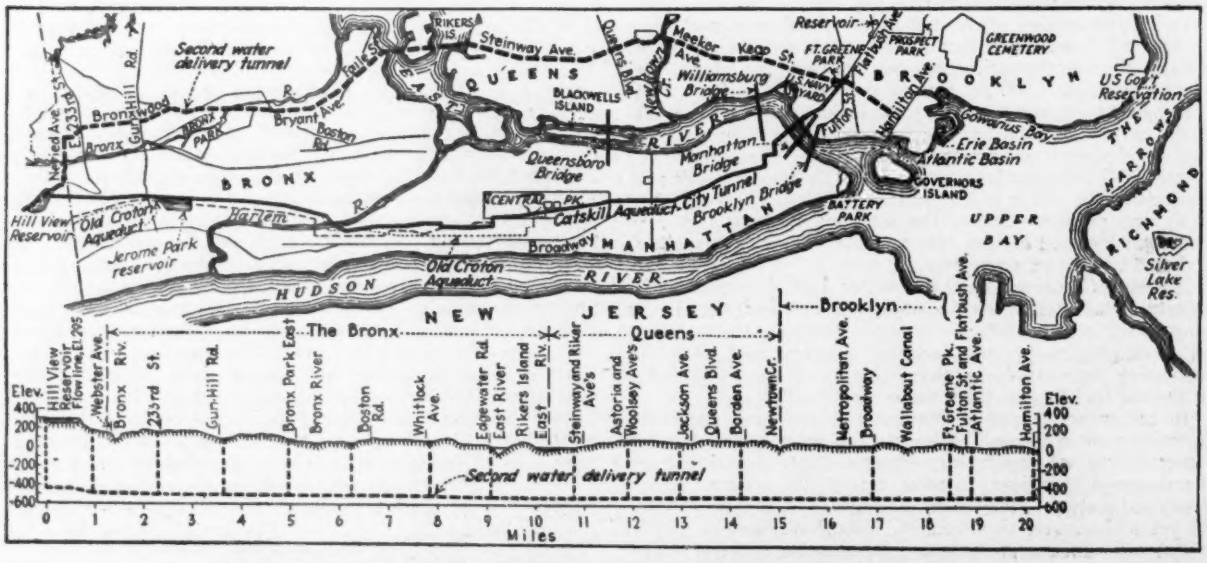
## War Over Cast-Iron and Steel Water Pipe for Dallas

### Relative Life and a Texas Insurance Penalty Involved—Local and Consulting Engineers Differ

A CONTROVERSY over whether steel or cast-iron pipe shall be used for a force main and for some branches tieing into the distribution system of the water-works of Dallas, Tex., will be continued in one of its phases on Oct. 8 at a hearing before the State Fire Insurance Board at Austin, Tex. At this hearing S. E. Moss, commissioner of water-works by virtue of his membership in the commission-council that governs Dallas, will attempt to have removed the fire insurance rate penalty of 5c. per $100 on the cities which have other than standard cast-iron pipe as a part of their water-distribution system—the last two words being construed to include force mains.

A few weeks ago Dallas advertised for a considerable mileage of water pipe, including 36- and 30-in. and smaller sizes. The call permitted bids for cast-iron, concrete or steel pipe, and for material and labor either separately or combined. Mr. Moss and two of his three fellow-commissioners (the fourth being absent) voted to accept a bid for longitudinally welded steel pipe but, a controversy having arisen in behalf of cast-iron pipe, the mayor vetoed the award.

A report by F. G. Cunningham, representing Fuller & McClintock, just made public, recommends cast-iron




NEW AND OLD CATSKILL WATER-SUPPLY TUNNELS FOR NEW YORK CITY

pipe rather than steel, regardless of the fire insurance penalty, even at a first cost of $200,000 above that of steel. This recommendation is based on an assumed life of cast iron at least double that of steel, as well as an assumed higher carrying capacity for cast iron after some years of use. Mr. Cunningham did not recommend, although he did not condemn, the type of steel pipe proposed. He stated that electrically welded steel pipe has been in use only some three years and is not yet widely enough used to make it a conservative choice in work of this importance. He also pointed out that the specifications for steel pipe invalidate a comparison of different bids for that material, in not confining the bids either to dipped or to brush-coated pipe. The pipe specifications, Mr. Cunningham states, were changed at Dallas so as to permit the use of electrically welded steel pipe after having been edited and approved by Fuller & McClintock. As to "lock-joint concrete cylinder pipe" of 36- and 30-in. diameter, says Mr. Cunningham's report, it would be an "acceptable alternative to standard cast-iron pipe," prices being equal, "judged on over-all merits."

The award vetoed by the mayor was that of the Uvalde Construction Company, of Dallas, for $1,177,000, including supplying and laying the pipe. The bids which Mr. Cunningham declares as the best offered are that for standard cast-iron pipe, offered by U. S. Cast Iron Pipe & Foundry Company combined with the bid for laying submitted by the Robeck-Humphreys Company, of Omaha, Neb., the two totaling $1,211,006.

## J. Waldo Smith Elected Honorary Member Am.Soc.C.E.

The election of J. Waldo Smith, consultant on water-supply problems to many of the larger cities of the United States and a past vice-president of the American Society of Civil Engineers, to honorary membership in that body was announced at the San Diego meeting.

J. Waldo Smith

Mr. Smith was graduated from Massachusetts Institute of Technology in 1887. He was employed for two years as assistant engineer for the Holyoke (Mass.) Water Supply Company, then went to the East Jersey Water Company as resident engineer and, later, principal assistant engineer on the design and construction of a 50-m.g.d. water supply for Newark, N. J. He was also chief engineer and superintendent for the Passaic, Acquackanonk and Montclair Water companies on maintenance, extension and operation of the water supplies of these systems. In 1901 Mr. Smith was appointed consulting engineer for the Jersey City Water Supply Company, in which capacity he directed the design and construction of a 50-m.g.d. supply for Jersey City, including the filtration plant at Little Falls, N. J.

Mr. Smith's connection with New York City began in 1904, when he was placed in charge of all construction work of the Croton water system, involving completion of the new Croton dam, the Muscoot dam, the Jerome Park reservoir and the design of the Cross River dam. In 1905 he became chief engineer of the New York City Board of Water Supply, and until 1922 was active in the development of the 500-m.g.d. supply from the Catskill Mountains. Since 1922 he has been consulting engineer for New York City, Philadelphia, Providence, Boston and Kansas City in water-supply matters, and acted as consultant on the Moffat tunnel in Colorado. He was awarded the John Fritz medal in 1918 for achievement in providing New York City with water. He is a member of the American Society of Civil Engineers, the American Society of Mechanical Engineers, the Institution of Civil Engineers of Great Britain, the American Water Works Association and other scientific and technical societies.

## Foundation Contracts Let for Three Mid-West Bridges

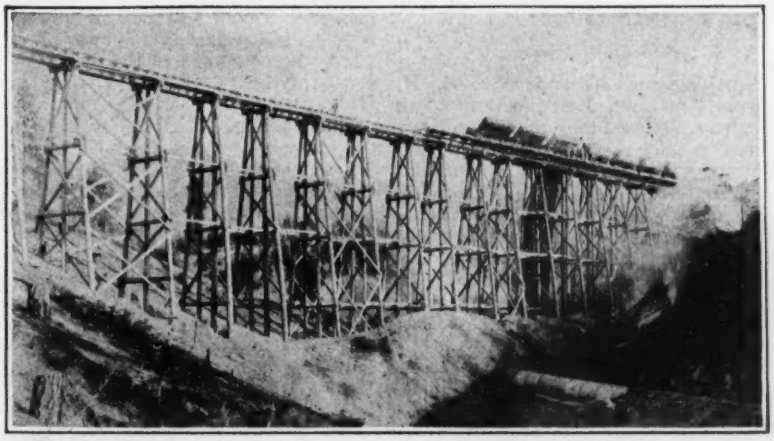
The awarding of contracts for construction work on the sub-structures of three toll bridges to be operated by the National Toll Bridge Company has been announced by J. G. White & Company. The bridges concerned are the Hermann bridge over the Missouri River at Hermann, Mo.; the Madison bridge over the Ohio River between Madison, Ind., and Milton, Ky.; and the Independence bridge to be erected across the Missouri River near Kansas City. The three contracts were given, respectively, to the Foundation Company, New York City; the Vang Construction Company, Pittsburgh, Pa.; and the Union Bridge & Construction Company, Kansas City, Mo. Completion of all three structures is expected before Jan. 1, 1930. Plans have already been approved by the War Department.

## Heavy Leakage Under High Rockfill Dam in California

When the Bowman dam, a rockfill structure 170 ft. high built by the Nevada irrigation district on the Yuba River in California, was first subjected to the pressure of a full reservoir, considerable leakage appeared at the downstream toe around the conduit through which water is drawn from the reservoir. Since the only control valves in this conduit are at the lower end, the conduit could not be unwatered for inspection. Under a head of 160 ft. of water the leakage at one time exceeded 100 sec.-ft., but it was found possible to reduce the flow to a comparatively small amount by forcing chips and small wood blocks into the upper end of the conduit, allowing them to be drawn by the current into the cracks in the conduit through which the leakage is believed to have occurred.

Now that the irrigation season is over, the reservoir will soon be emptied and inspection of the conduit will then be made. A detailed report of findings will be published in *Engineering News-Record* as soon as facts as to the cause of leakage can be ascertained.

### BUILDING THE NEW CHUMSTICK LINE OF THE GREAT NORTHERN RAILWAY



**The illustration shows the building of a high fill on the new Chumstick line of the Great Northern Railway, which has just been opened to traffic. This line, 17¼ miles long, has been built between Peshastin and Winton, Wash., at a cost of $5,000,000. It eliminates 46 curves, has a maximum curvature of 3 deg., and reduces the maximum grade by almost 30 per cent. Another important advantage of the new line is its freedom from the hazard of snow tie-ups. There are three tunnels, the largest 1 mile in length, and a 360-ft. steel bridge across the Wenatchee River. The tunnels are lined with 3-ft. concrete walls. The Chumstick Line was built by A. Guthrie & Company, St. Paul, Minn., which company is also building the Great Northern's Cascade tunnel, now nearing completion.**

## New Orleans Abandons Union Station Plan

The Public Service Commission of Louisiana has definitely given up the idea of constructing a union station in New Orleans and has instructed the Illinois Central Railroad to prepare final definite plans for the new $8,000,000 station, preliminary details of which were submitted to the commission nearly two years ago. This decision will have the effect of eventually substituting two passenger terminals for the proposed union station. It is expected that the Southern Pacific, the Mississippi Valley and the Gulf Coast Lines, which now use the Illinois Central station, will be transferred to the new structure when it is completed. Accommodations will also be provided for the Texas Pacific, the Missouri Pacific and the Louisiana Railway & Navigation Company when they are ready to move in.

Although no plans have been made public, it is believed that construction of a second terminal, to be situated below Canal St., will take place soon. This will probably care for the Southern, the Great Northern and the Louisville & Nashville railways.

## Subjects for Railway Bridge and Building Convention

Papers and reports for presentation at the annual meeting of the American Railway Bridge and Building Association at Boston, Mass., on Oct. 23-25, include the following: "Relative Merits of Jacking and Tunneling for New Culverts Through Railway Fills," J. S. Huntoon, assistant bridge engineer, Michigan Central Railroad; "Proposed Railway Bridge Across Suisun Bay, California," H. I. Benjamin, assistant engineer, Southern Pacific Railway; "Co-operation Between Field Forces and the Stores Department," L. M. Bates, division engineer, Chicago & Northwestern Railway; "Railroad Experiences in the 1927 Flood," W. J. Backes, chief engineer, Boston & Maine Railroad, and C. E. Donaldson, superintendent of bridges and buildings, Central Vermont Railway; "Wrecking and Salvaging Railway Buildings," W. T. Krausch, engineer of buildings, Chicago, Burlington & Quincy Railroad; "Painting Railway Buildings," Kemper Peabody, supervisor of buildings, New York Central Railroad; "Organization and Equipment for Emergency Work," C. D. Turley, supervisor of track, Illinois Central Railroad; "Economical Operation and Maintenance of Water Stations," R. C. Bardwell, superintendent of water service, Chesapeake & Ohio Railway; "Construction and Placing of Precast Concrete Slabs," H. A. Gerst, assistant bridge engineer, Great Northern Railway.

The president of the association is F. C. Baluss, office engineer, Duluth, Missabe & Northern Railway; the secretary is C. A. Lichty, general inspector, Chicago & Northwestern Railway, Chicago, Ill.

# Code Discussed at Construction Section of Safety Congress

### Speakers Argue For and Against Laws Governing Safety — Architects Propose Safety Specifications

THREE HUNDRED construction men from all parts of the country met in the construction section of the National Safety Congress held in New York Oct. 1-5, in an effort to find means of stopping the rapidly mounting toll of accidents within their industry. The congress as a whole was attended by more than 6,000 delegates representing every employing industry in the nation. Five hotels were needed to accommodate the 110 separate sessions held under the auspices of the congress, at which some 325 speakers were heard.

The construction section opened its meetings with a well-attended luncheon Oct. 1, after an address earlier in the day by Homer E. Neiz, president of the National Safety Council, to the general congress. A plea for education in safety work rather than mandatory codes was made at the opening session by Walter S. Faddis, president, Building Trades Employers Association of the City of New York. Existing safety laws were vigorously upheld by John Sullivan, president, New York State Federation of Labor, who stated that the laws were serving their purpose in forcing the employer to recognize the hazards of many occupations, and now it was up to labor to do its share in continuing the work of accident prevention. Mr. Sullivan further stated that the class of employer requiring a code to force him into safety work was rapidly diminishing and for the most part employers are now taking an active interest in protecting the safety of their workers.

#### Safety Code Advocated

Speaking for the architects, R. H. Shreve, president, New York Building Congress, declared that neither code nor education alone could accomplish the utmost in accident prevention, but that a moderate consideration of both should be used. "My own sympathy and understanding," said Mr. Shreve, "go out fully to labor, which, in the absence of other compulsory protection, seeks the help of the law. To do these men justice and to provide reasonable standards before we are perhaps saddled with unreasonable ones, we should seek effective action." The American Institute of Architects is preparing a set of specifications of safety standards which, if adopted, will become part of the standard specifications issued by architects.

An illustrated lecture on actual safety practices as carried out in the construction of the East River plant of the New York Edison Company was given by F. E. Cudworth, who was construction superintendent on the project. R. B. Thomas, counsel, Structural Steel Board of Trade, New York, showed how nearly all the accidents on steel erection work, admittedly one of the most hazardous occupations in the construction industry, were caused by sheer carelessness on the part of the steel workers themselves or workmen of other trades around the job.

A committee was appointed to study the cause and frequency of accidents in tunnel and caisson work, and to prepare a report for the next annual meeting. At present there are few data available concerning this class of accidents. R. McA. Keown, engineer, Industrial Commission of Wisconsin, was made chairman of the committee. Francis Donaldson, Mason & Hanger Company, was appointed the head of a local New York committee to co-operate with the national committee. Other local committees will be formed in various sections of the country.

Officers of the construction section for the coming year are: chairman, W. R. Richards, field secretary, Associated General Contractors, Washington; publicity chairman, J. Wilson Robinson, Everett Winters Company, Detroit; program chairman, J. W. Dalzell, Ferro-Concrete Construction Company, Cincinnati; news-letter chairman, George Widua, Woods Brothers Construction Company, Lincoln, Neb.; poster chairman, Robert McKinley, General Accident Insurance Company, Detroit; secretary, G. H. Black, Stone & Webster Engineering Corporation, Boston.

#### Street Traffic

Safety in street traffic was the subject of two sessions of the public safety division. The morning session was devoted to the presentation of the A.E.C. reports on signs and markings and on signals and to a paper "When Are Traffic Signals Justified?" by E. P. Goodrich, of New York. The afternoon session was given over to a round-table discussion of two papers, one by Prof. R. L. Morrison, of the University of Michigan, on "Practical Means of Building Safety in Streets and Highways," and one by Percy Straus, of the R. H. Macy Company, on "Off-Street Loading and Night Deliveries."

The National Safety Council elected the following officers: president, Henry A. Reninger, Lehigh Portland Cement Company, Allentown, Pa.; vice-presidents, Charles E. Hill and George Opp, New York Central Lines; A. M. Tode, Texas Oil Company, New York; Miller McClintock, Harvard University; Prof. C. E. A. Winslow, Yale University, and George Sanford, General Electric Company, Schenectady.

## Engineer to Speak on Arc Welding

In response to invitations from a number of technical societies Frank P. McKibben, structural and bridge engineer, is planning an extensive tour to deliver his lecture on the application of electric arc welding to noiseless building construction before engineering societies in more than 30 cities in the United States and Canada.

## Construction of New Texas Railway Recommended

A report submitted to the Interstate Commerce Commission by a special investigator of that body recommends the approval of the construction by the Cane Belt Railroad, a subsidiary of the Santa Fe, of a new 35-mile line in Texas extending from a point on the Lane City-Magnet line northeast to a connection with the Gulf, Colorado & Santa Fe Railway near Towson. In the same report the examiner recommended denial of the application of the St. Louis, Brownsville & Mexico Railway, a subsidiary of the Missouri Pacific, to construct extensions serving the same territory.

The report states that the immediate occasion for both applications is the expected development of a large sulphur mine at Bowling Dome. This is now served only by a spur from the Southern Pacific. The Santa Fe project would also serve as a cutoff on its route between points on the Cane Belt Railroad and Galveston, a feature which would alone, in the opinion of the investigator, justify construction of the new line.

## Canada Leases Power Site

A 30-year lease of the Seven Sisters Falls water-power site on the Winnepeg River in Manitoba has been granted by the Canadian government to the Northwestern Power Company, a subsidiary of the Winnipeg Electric Company. The company has agreed to develop 60,000 hp. within three years, and the Province of Manitoba is given the right to take over the property at the expiration of the 30-year period. The site is regarded as unusually valuable, since the ratio of maximum to minimum flow is only about four to one.

Although the grant was made at the request of the Province of Manitoba, it has aroused considerable opposition among the advocates of public ownership. The federal authorities have already agreed to surrender control of the water-power resources of the province to the provincial government, and it is contended that the grant should have been withheld until this action had been taken.

## City Problems to Be Discussed at Detroit Convention

A program treating many municipal problems has been planned for the annual convention of the American Society for Municipal Improvements, to be held at Detroit, Mich., Oct. 22-26. Although the formal opening of the convention will not take place until the evening of Oct. 22, the afternoon will be taken up with a number of committee meetings. In addition to the usual convention business, specially prepared papers will be presented on a number of subjects. Among these may be mentioned the following: "The Water Supply of Detroit, Mich." by F. H. Stephenson, engineer of water system construction and maintenance, Detroit, Mich.; "Digestion of Fine Screenings," by Dr. Willem Rudolfs, chief and biochemist of the sewage substation of the New Jersey Agricultural Experiment Station, New Brunswick, N. J.; "Operating Experiences With Activated-Sludge and Fertilizer Manufacture," by James Brower, master mechanic, sewerage commission of the city of Milwaukee, Wis.; "Systems of Sewage Aeration," by George B. Gascoigne, consulting sanitary engineer, Cleveland, Ohio; "A National Perspective of Concrete Street-Paving Specifications," by L. S. Trainor, manager, highways and municipal bureau, Portland Cement Association; and "The Construction and Maintenance of Urban and Rural Brick Pavements," by Fred E. Swineford, director of public service, Akron, Ohio. The convention will close with a golf tournament to be held Oct. 26.

## Subway Contracts Awarded for Brooklyn and Queens Lines

Two additional contracts for subway construction in New York City's new subway system have been awarded in Brooklyn and Queens by the Board of Transportation. The Necaro Company, Inc., was awarded the Schermerhorn St. section, extending from Court to Bond St., Brooklyn, at a contract price of $5,612,034.10. The Jackson Ave. and Northern Blvd. section in Queens, extending from Queens St. to 37th St., Long Island City, was awarded to the G.W.T. Construction Company, Inc., for $6,974,731.

## Canadian Government Awards Dam and Bridge Contracts

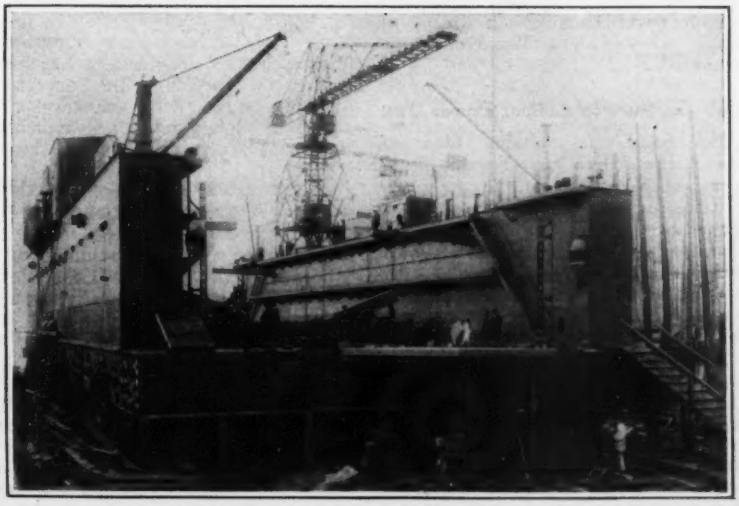
The contract for the construction of a submerged stone dam in the St. Lawrence River near Sorel, Que., has been let by the Canadian government to Robinson & Jamin, Ltd., for $899,000, with additional allowance for piling and rock filling. The dam will be unique in that it does not cross the channel but extends out from both banks of the river. Its purpose is to hold back sufficient water to insure permanent levels in the navigation system and it is expected to compensate in some degree the alleged effects of the Chicago drainage diversion.

The Dominion Bridge Company, of Montreal, has been awarded the contract for a lift bridge at Welland, across the Welland Canal, by the Canadian Department of Railways and Canals for $654,320.

## To Eliminate Four Long Island Grade Crossings

Elimination of four grade crossings of the Long Island Railroad at Valley Stream, L. I., has been directed by the Public Service Commission of New York State. The railroad will be elevated in accordance with a plan filed by the railroad at a hearing on May 4, 1926. The estimated cost of the work, which will also include extended improvements in railroad facilities at Valley Stream, is $2,980,000, exclusive of land and property damage.

## FLOATING DRY DOCK BUILT IN ENGLAND FOR 750-TON VESSELS



**This steel self-docking dry dock, 194 ft. long by 61 ft. wide, has been built for the British Tanker Company at Newcastle, England. The walls are caissons to be flooded when sinking the dock for loading. The dock is floated by means of four pontoons, each 42 ft. long. The main pumping machinery consists of a Diesel engine driving a centrifugal pump of the horizontal type. A depth of water of 22 ft. is required at the docking site. The dock is capable of being sunk to a depth over the keel blocks of 12 ft. 6 in. It is said that it requires only two hours to raise a 600-ton ship with a 10-ft. draft. Clark & Standfield, London, were consulting engineers, and the dock was constructed by the organization of Sir W. G. Armstrong, Whitworth & Company, Ltd., Newcastle-on-Tyne.**

# WASHINGTON NOTES

By Paul Wooton
*Washington Correspondent*

## Mississippi Progress—Alabama Power Tax—Co-ordination of Public Engineering Projects

NEW records in levee construction will be established during this working season, Major-Gen. Edgar Jadwin, Chief of Engineers, predicts, after a visit to the St. Louis offices of the Mississippi River Commission. While the unusual duration of high water this fall delayed the starting of levee work, it gave an opportunity for advance planning and the assembly of plant, with the result that construction is proceeding at an unprecedented rate, General Jadwin asserts.

A hydraulic laboratory will be set up at some point on the lower river, General Jadwin announces, just as soon as a report can be made by Col. Edward M. Markham, who is now in Europe familiarizing himself with the work and equipment of hydraulic laboratories there. Colonel Markham is accompanied by Lieut. John P. Dean, who has been engaged in an intensive study of hydraulic problems in connection with the canalization of the Ohio. In the meantime work is progressing with the construction of a small-scale model of the Bonnet Carré spillway. One of the chief problems there, due to the instability of the soil, is the hydraulic jump. In that connection it is pointed out that scour has been minimized at the Gatun dam spillway by forcing the outflow against pillars in such a way as to set up a backwash which dissipates much of the force of the falling water.

### Working of "Fuse Plugs"

Questions which have been raised as to the volume of discharge through the fuse-plug sector are answered to the effect that it is expected that the first crevasse soon would choke and limit the outflow of water, but it is asserted further that the stage of the river then would rise until another crevasse occurs at some other point in the so-called plug. Prior to any crevasse, the water flowing over the 35-mile sector, which is 3 ft. lower than the main river levee, would keep the stage of the river at least 2 ft. below the top of the levee line, as the 35-mile "notch" was estimated as being ample for that purpose.

### Pacific Coast Projects Progressing

General Jadwin who has just completed a general river and harbor survey on the Pacific Coast, reports that the work on the projects under way is progressing satisfactorily and that these waterways are serving well the growing commerce of the Western coast. During the last three weeks of his trip he inspected the principal harbors from San Francisco to Portland. He has also visited navigation, flood and débris projects and certain power and irrigation projects in the Sacramento and San Joaquin valleys. He also visited projects in eastern Oregon and in Washington on which the district engineers are now making surveys.

### Who Will Be Chief of Engineers?

An effort to secure the appointment of Col. William P. Wooten as Chief of Engineers to succeed General Jadwin when the latter reaches retirement age on Aug. 7, 1929, is taking form in the lower Mississippi Valley, where there is widespread dissatisfaction with the Jadwin plan for the control of Mississippi River floods. It is known that Colonel Wooten shares some of the objections advanced in that section against the plan. Moreover, he made a very good impression locally in connection with the work of the spillway board, of which he was chairman. One of the reasons being advanced for the selection of Colonel Wooten for this post is the advantage of having the entire project worked out under the direction of one man. He will not reach the retirement age until Feb. 14, 1937.

The belief in Washington is that the chances are very much against the success of any such movement, as it would mean the jumping of several senior officers who are well qualified to carry on the work. Since the creation of the office of assistant Chief of Engineers, it has been customary to advance that official to the chiefship. There is nothing in the record of Gen. Herbert Deakyne, the incumbent of that office, which could be used against him. His appointment apparently will be opposed, however, on the ground that he is in full accord with the Jadwin plan. There will be valley support also for Col. C. W. Kutz, who was a member of the Mississippi River Commission during the period when its flood-control studies were made.

### Alabama Sues to Collect Power Tax

The State of Alabama filed suit against the federal government in the Court of Claims Sept. 11 to collect $173,051 to cover the tax on hydro-electric power sold by the War Department during the calendar year 1926. In addition, the state seeks to collect a penalty of 15 per cent and interest at 8 per cent since the tax became due. The petition points out that the state has levied a privilege tax of two-fifths of a mill upon each kilowatt-hour of hydro-electric power manufactured and sold within the state. During 1926, the petition states, the United States sold 432,629,000 kw.-hr. of hydro-electric energy to the Alabama Power Company. When the bill was presented to the federal government payment was refused on the ground that a state may not tax a federal agency.

### Government Engineering Control

An advisory committee of engineers, to be chosen from within and without the government service, to make recommendations for the handling of the government's major engineering problems is under discussion in Washington. The proposal is suggested as a stop-gap until a general plan of departmental reorganization can be brought about, or in lieu of an engineering department if that should be found impossible of accomplishment. It is the intention that the advisory committee, which would be named by and report to the President, would be comprised of engineers of national standing whose recommendations could not be treated lightly by department heads or by the director of the budget.

It is recognized that there are limitations to the effectiveness of such a committee. No occasional group meeting can keep situations so well in hand or devote as much attention to detail as might a permanent organization embodied in a department of public works. As a temporary measure, however, such a plan would lay the foundations for the direction of the proposed department and facilitate co-ordination of activities now manifestly lacking.

# *Brief News*

Announcement Has Been Made of the consolidation of the Winston Bros. Company and the Winston-Dear Company to be known as the Winston Bros. Company, constructors and engineers, Minneapolis, Minn.

Dredging and Channel Straightening on the Wabash River in Ohio and Indiana will be started in the near future. A 24-mile section of the stream will be widened and shortened by 8 miles, involving the removal of about 1,000,000 cu.yd. of gravel.

A New Steel Bridge across the Saskatchewan River at Nipawin is being constructed by the Canadian Pacific Railway. This structure will be 1,840 ft. long, with an approximate height of 150 ft.

Bondholders of the defunct Alabama & New Orleans Transportation Company have offered to sell to the War Department the canal connecting the Mississippi River with Lake Borgne, below New Orleans. It is contended that this waterway can be used to advantage by the Inland Waterway Corporation.

Increasing the Building Height Limit in Memphis is recommended by Mayor Overton in a letter to the city planning commission. The present ordinance regulates buildings to twelve stories.

Construction of Barriers in the Scioto River near Portsmouth, Ohio, has been decided upon by the Ohio Highway Department in an effort to protect an improved road which is now being undermined by the swift current. The barriers will be 3,000 ft. long and will cost approximately $25,000.

## Engineering Societies

### CALENDAR

**Annual Meetings**

SOUTHWEST WATER WORKS ASSOCIATION, Fort Worth, Tex.; annual convention, Dallas, Tex., Oct. 15-18.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York, N. Y.; annual convention, Chicago, Ill., Oct. 15-19.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Louis, Mo.; annual convention, Detroit, Mich., Oct. 22-28.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION, Chicago, Ill.; annual convention, Boston, Mass., Oct. 23-25.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION, New York, N. Y.; annual convention, Biloxi-Gulfport, Miss., Nov. 13-17.

---

THE AMERICAN ENGINEERING COUNCIL administrative board will meet Oct. 19-20 at Pittsburgh, Pa.

THE BOSTON SOCIETY OF CIVIL ENGINEERS on Oct. 10 heard Stoddard B. Bates, Commissioner of Highways of Vermont, speak on "The 1927 Flood and Subsequent Reconstruction of the Highway System of Vermont."

THE COLORADO ENGINEERING COUNCIL has passed a resolution approving the action of Mayor Stapleton of Denver in going outside of the city for expert engineering advice. This action was taken as a result of popular criticism of this course.

THE DETROIT ENGINEERING SOCIETY, at a dinner meeting Oct. 5, viewed motion pictures of the construction of the Detroit bridge, which were explained by Robert MacMinn, engineer of construction for the McClintic-Marshall Company, and R. G. Cone, engineer of construction for Mojeski & Chase. An inspection trip to the structure was made the following day.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS will hold a regional meeting Oct. 29-31 at Atlanta, Ga.

THE NATIONAL MUNICIPAL LEAGUE will hold its annual meeting Oct. 16-17 at Cincinnati, Ohio.

THE AMERICAN ASSOCIATION OF PORT AUTHORITIES annual convention will be held at Houston, Tex., Nov. 12-14, and at Galveston, Tex., on Nov. 15. A special invitation has been issued to all visitors to the convention by the Dock Board of New Orleans to stop over and inspect the port facilities in that city. The headquarters of the association are in Room 200, New Orleans Court Building, New Orleans, La.

THE OHIO CONFERENCE ON SEWAGE TREATMENT will be held Oct. 31 at Marion, Ohio. The program will include papers and discussions on new sewage-treatment plants, and considerable time will be given to the discussion of proper financing of sewage-treatment operations. Included in the latter topic will be the subject of sewer rental ordinances and sale of sludge for fertilizer purposes. The conference will close with an inspection of the Marion sewage-treatment works. C. D. McGuire, chemist in charge of the Columbus sewage-treatment plant, is conference chairman.

THE OHIO CONFERENCE ON WATER PURIFICATION will meet this year at Lima, Ohio, Nov. 1-2. The first day's program will be given over to papers and discussions on water-purification and softening problems. The second day will include inspection of the Lima filtration plant and a trip to the new Piqua water-softening works.

---

## Personal Notes

FRED A. NOETZLI, consulting hydraulic engineer, Los Angeles, has been appointed special consultant by the Los Angeles County Flood-Control District for an analysis of the inclined stresses in the proposed San Gabriel dam.

JOHN R. PEAVY, formerly asistant city engineer and for seventeen years connected with the city engineering department of Mobile, Ala., has been appointed county highway engineer of Mobile County, to succeed J. B. Converse.

THOMAS GUARDIA, chief engineer of the Junta Central de Caminos (Central Roads Board), Panama, has agreed to continue in this post for four more years. The board will supervise the building of the new government highway from Santiago de Veraguas to David, Province of Chiriqui, at a cost of over $4,000,000.

BERNARD BLUM and A. S. STOTLER have been appointed chief engineer and assistant chief engineer, respectively, of the Northern Pacific Railway. J. T. Derrig, formerly district engineer, will be assistant to the chief engineer. He will be succeeded by H. F. Brown, formerly assistant district engineer at St. Paul. P. E. Thian, formerly valuation engineer, has been appointed to the newly created post of consulting engineer. He will be succeeded by A. C. Terrell.

J. C. FITTERER, professor of civil engineering and hydraulics at the University of Wyoming, has accepted the chair of assistant professor of mathematics at the Colorado School of Mines, relieving Prof. E. P. Martinson, who has resigned to become an executive of Consolidated Industries, Inc., of Rockford, Ill.

R. C. MARSHALL, JR., has been made president of the Sumner Solitt Company, builders, of Chicago, Los Angeles and San Antonio.

EDWARD M. DE MUNN, former street commissioner, and RICHARD E. CHAMP have been named superintendent and assistant superintendent, respectively, of the Geneseo (N. Y.) water-works. They succeed the late George R. Meeker, who held the position of superintendent of the water branch for more than fourteen years.

GEORGE M. BULL, Denver hydraulic engineer, has become directly connected with the Denver Water Board, after serving as a consulting engineer to the board for the last five years.

HERBERT L. DUNN, formerly with the Merritt-Chapman & Scott Corporation, of New London, Conn., is now in the radio engineering department of the Westinghouse Electric & Manufacturing Company, at Chicopee Falls, Mass.

LESTER V. BRANCH, of New York, has been appointed resident manager of the Connecticut River Development Company, which is building the Fifteen Miles Falls project in the Connecticut River near St. Johnsbury, Vt., and Littleton, N. H., for the Grafton Power Company, a part of the New England Power Association.

W. STEINBRUCH, of Drexel Hill, Pa., recently supervising engineer for the receivers of the Sesquicentennial Exhibition Association in Philadelphia, has accepted a position with Strawbridge & Clothier, of Philadelphia, as assistant supervising engineer in charge of the construction of that company's new department store and new remote delivery station.

Capt. LEONARD S. DOTEN, Q. M. C., U. S. Army, has assumed the duties of constructing quartermaster, Wright Field, Dayton, Ohio. He has recently returned from a three-year tour of duty in the Hawaiian Department, where he was in charge of the construction work of the army.

ARTHUR C. TOZZER, vice-president of the Turner Construction Company in charge of the Boston territory, has been elected executive vice-president of the company, with headquarters at the main office in New York. WILLIAM H. NYE, Boston contract manager, has been elected vice-president in charge of the Boston office to succeed Mr. Tozzer.

S. J. DAVIS, for the past three years construction engineer for the Marland refinery, of Ponca City, Okla., is now resident engineer for Cosden & Company, Inc., at Big Spring, Tex.

WILLIAM SMAILL, chief engineer of the Northern Construction Company, Ltd., & J. W. Stewart, has moved his headquarters from Vancouver to Detroit and Windsor to supervise the contracts which the company has recently taken from Porter Brothers & R. Porter, general contractors for the Detroit-Windsor tunnel. The contracts consist of the land tunnels on both sides of the river to connect with the tube under the river. The work will be carried out with compressed air, using a shield 33 ft. in diameter.

# Construction Equipment and Materials

## Cinder Block Patent Upheld

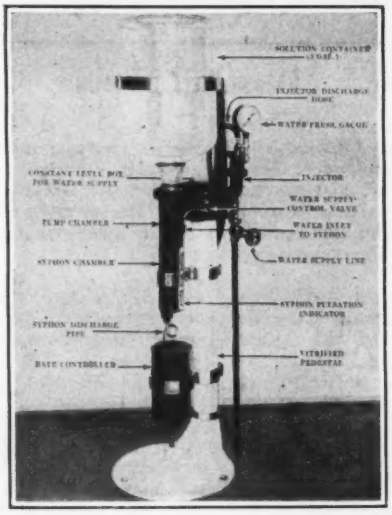
The validity of the patent issued to Francis J. Straub and now owned by Crozier-Straub, Inc., Philadelphia, Pa., which covers the manufacture of cinder concrete building blocks, has been upheld by a decision of the United States Circuit Court of Appeals for the Third Circuit at Philadelphia, Pa. Blocks made by the Straub process have as constituents cement, water and "a mixture of coarse and fine coal cinders and ashes, retaining all the original mass." The patentability of the product resides largely in the last characteristic. In the opinion of the court, "no one before Straub had, when making building blocks, conceived the idea of taking the whole ash product—cinders and ash alike, half-burned and wholly burned, lumps and dust—in fact, the entire run of the grate, using the whole waste product in its raw state and rolling or grinding the whole mass." In this instance in the cases at bar, three in all, the defendents were declared to have infringed the Straub patent 1,212,840.

# New Developments

## Chlorinating Apparatus for Small Water Supplies

A new chlorinating device known as a chlorinizer has recently been developed by the Paradon Manufacturing Company, Arlington, N. J., for the application of prepared chlorine solutions and other chemical solutions in small amounts. The chlorinizer is hydraulic in operation, contains no moving parts, operates by turning a water faucet, permits no valves or mechanical devices to come in contact with the chemical and contains a minimum number of parts. Corrosion by chlorine is claimed to be eliminated. The minimum capacity of the chlorinizer is practically unlimited, according to the Paradon company.

In operation the chlorine solution is contained in an inverted 5-gal. carboy. The partial vacuum in the top of this container maintains a constant level of solution in a small reservoir, known as the pump chamber, located beneath the carboy. Another chamber, the siphon chamber, is intermittently emptied by an automatic siphon operated by a small auxiliary water supply. The siphon chamber is connected by a meter tube with the pump chamber. When the siphon chamber is emptied, a constant volume of air is trapped in the meter, and as the siphon chamber fills, this air is forced into the pump chamber. It displaces a corresponding volume of solution, forcing it into the siphon chamber. From the siphon chamber, water plus the chemical is discharged into a rate controller, from which it flows by gravity to the point of application. The rate controller maintains a uniform discharge of chemical solution, although the inflow is of course intermittent.




For any given operation, the strength of the primary solution and the size of the meter tube are constant, so that the only variable is the number of siphon pulsations, which latter are regulated by the flow of water to the siphon chamber.

## Armored Concrete Pavement

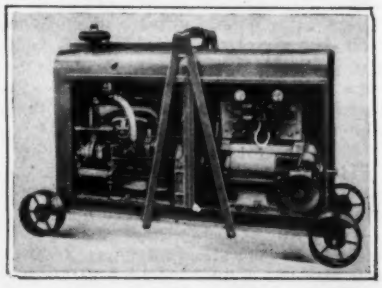
A system of concrete roadway reinforcement designed to stand up under heavy and intense traffic has been developed by the Pont-a-Mousson Company, French cast-iron pipe manufacturer. It consists of a network of individual cast-iron cups or shells laid on an appropriate base, the cups and interstices between being filled with a quick-hardening cement. The procedure is naturally costly but is considered of value to heavy fast traffic crossroads, squares, railway station quadrangles, etc. Lengths and areas of considerable proportions have been laid in Paris, at Lyon and various other points, according to reports.

FIG. 1—CAST-IRON CUP REINFORCEMENT AT RAILWAY STATION PLAZA, NORD FRANCE

FIG. 2—CAST-IRON CUP HIGHWAY REINFORCEMENT NEAR PARIS

## Special Winding on Welder Gives Flexibility and Heat Control

The electric arc welding machine manufactured by the Electric Arc Cutting & Welding Company, 152 Jelliff Ave., Newark, N. J., is known as the "Dualarc" welder. It is claimed to be the only electric welding machine which can be operated both as a compound-wound generator and a differentially wound generator. In the first instance, the machine generator delivers 40 volts for carbon or metallic-arc welding. Such a voltage is claimed to give stability to the arc and quick penetration on rusty and dirty surfaces. It is also advantageous in windy places. When operating as a differentially wound generator the machine provides 20 volts for metallic-arc welding, automatically providing the proper reactance to suit all conditions of load. This feature is claimed to prevent a self-reversal of polarity and is used to advantage in welding thin sheet metal. Independent control of voltage and amperage is another important feature, for on some work a low voltage and high amperage are necessary, while on others a high voltage and low amperage produce best results.



Although the machine is operated by direct current, it can be equipped with slip rings to provide alternating-current supply for operating electric drills, grinders and droplights. A shaft ex-

tension on the generator supplies a means of direct connecting air compressors and other machines. The motor-generator set is close-coupled, insuring positive alignment, and is equipped throughout with ball bearings. The standard gas engine installation is a Continental model P-20.

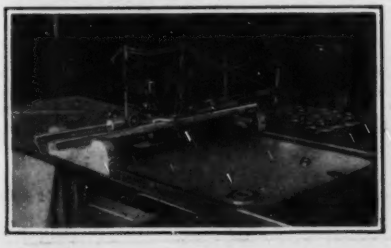
### Slack-Pullers Hold Wire Until Clamps Are Attached

Special tools for removing slack from guy wires and holding the wires with the exact pull required until clamps can be applied have been developed by the W. N. Matthews Corporation, St. Louis, Mo. They are known as quick-release

slack-pullers and are of special advantage where several guys are used and equalization of the strain on all guys is necessary. Other advantages claimed by the manufacturer are that the slack-pullers eliminate loss of time incident to rigging up blocks and tackle, eliminate the jerks common to block-and-tackle guy tightening and increase the speed of tightening by virtue of the quick-release feature. The slack-pullers are also said to be much less cumbersome than block and tackle. They are furnished in three sizes for 3,000-, 6,000- and 10,000-lb. pulls. In some of these models a special gear ratio is used which permits light pulls to be exerted very rapidly.

### Gas Shape-Cutting Machine for Steel Fabricators

An automatic oxy-acetylene shape-cutting machine designed to cut shapes of any sort from steel plates, sheets, forgings, billets or ingots is being introduced by the Linde Air Products Company, 30 East 42nd St., New York.



In this machine the cutting blowpipe is mounted on a carriage which is moved in any direction by means of an electric motor. For routine production it will operate automatically from templets. In cases where only a few parts are to be cut out, a hand tracing device can be attached and used to follow the outline of a sketch or blueprint. The parts of the machine are sturdily built without impairing the delicacy of adjustment necessary in a precision instrument of this sort.

The Oxweld shape-cutting machine requires but one operator. Little machining is said to be necessary after cutting, because the parts are produced with straight corners and smooth faces. The speed of cutting ranges from 3 to 20 in. per minute, depending on the thickness of the metal. Accurate and smooth cuts can be made in stock up to 1 ft. and more in thickness.

## *Business Notes*

AMES SHOVEL & TOOL COMPANY, North Easton, Mass., announces the beginning of its new blade factory, which will be a single-story structure 400x60 ft. The purpose of the new addition is to rearrange the plant for line production. When the new addition has been completed, it will afford the plant 200,000 sq.ft. of floor space, or nearly five acres. The present capacity of the plant is 6,000 shovels a day for a single shift. The Ames Shovel & Tool Company was recently taken over by Stone & Webster and the new building is part of a general expansion program.

GALION IRON WORKS & MANUFACTURING COMPANY, Galion, Ohio, has been awarded a patent covering the automatic pivotal rear axle used on its E-Z lift adjustable leaning wheel graders, for which feature the company makes broad claims, one of the most important of them being that it takes care of certain forces on the rear end of the grader that tend to cause the machine to slide sideways. It is also claimed that this device prevents the ditch wheel from cutting and crowding into the bank and thus spoiling the ditch.

CHICAGO PNEUMATIC TOOL COMPANY, New York City, announces the completion of a new foundry at Franklin, Pa., where all gray iron castings for its compressors and engines will be made. The buildings and equipment represent an investment of over $400,000. About 225 men will be employed.

PIERCE GOVERNOR COMPANY, Anderson, Ind., has completed the transfer of its entire factory and executive offices to its new plant, which was acquired from the R. J. Wright Manufacturing Company and completely reconstructed at an expense of approximately $50,000. The building provides a little more than 40,000 sq.ft. of floor space. In addition, the ground purchased with the new plant covers about four acres. It is said that at the present time about 357 manufacturers of automotive and industrial machinery use Pierce governors as standard equipment. The new building will give the Pierce Governor Company room for needed expansion.

JOSEPH T. RYERSON & SON, INC., has acquired the plant, merchandise and good will of the E. P. Sanderson Company, Cambridge, Mass. This will give the former company a large increase in plant facilities and tonnage. The E. P. Sanderson plant is the largest and most complete of its kind in the New England territory.

KOPPEL INDUSTRIAL CAR & EQUIPMENT COMPANY, Pittsburgh, announces that H. E. Chilcoat has joined the organization as manager of sales, air dump car division. Mr. Chilcoat, after being advanced from inspector to foreman of the air brake department of the Pennsylvania Railroad, became traveling inspector for the Westinghouse Air Brake Company in 1906, subsequently being transferred to the sales department, where he continued until 1918, resigning to accept a position as manager of the Clark Car Company. During the past 2½ years Mr. Chilcoat has been engaged in consulting engineering work for himself.

## *New Publications*

*Tunnel Boring Machine*—WINTERBOTTOM CONNELLY COMPANY, Cleveland, Ohio, has issued a small eight-page booklet describing the "Mole," a machine for boring tunnels varying from 5 to 7 ft. in diameter through shale, sandstone or limestone.

*Slackline Excavators* — STREET BROTHERS MACHINE WORKS, Chattanooga, Tenn., describes and illustrates a number of typical installations of its slackline excavators in bulletin No. 58. This also contains detailed description of each part of the apparatus and a table of average hourly capacities for figuring approximate operating costs.

*Centrifugal Pumps* — ALLIS-CHALMERS MANUFACTURING COMPANY, Milwaukee, Wis., has issued bulletin No. 1632-J, a 74-page illustrated book giving full description of the Allis-Chalmers line of centrifugal pumps. There are a number of tables giving the capacities and dimensions of the various sizes of pumps, and also a series of pipe friction tables.

*Excavating and Handling Equipment*—LINK-BELT COMPANY, of Chicago, Indianapolis and Philadelphia, has issued a 48-page book describing the entire Link-Belt line of cranes, shovels, draglines and similar material-handling equipment. A large number of photographs illustrate various models in actual service. The book also gives complete specifications and dimension diagrams.

# The Business Side of Construction

## Relation of Money Rates to Construction Financing

One of the basic factors underlying general construction is the ability to borrow money at reasonable rates of interest. Borrowing of money is common to almost all construction, whether it be private or public in nature. It is but natural, therefore, that the construction industry should be keenly interested in the rates at which money can be secured, and this interest is especially prevalent during a period such as the present, when money rates are unusually high.

The reference to the money market appearing in the financial pages of every daily newspaper has undoubtedly led many of those in the construction industry to inquire as to the characteristics of such items as "call loans," "collateral or time money" and "commercial paper." Which of these types of money rates is indicative of the amount which the construction industry must pay for capital to finance new projects?

Rates of interest which a borrower must pay for money are determined by the law of supply and demand. This law works throughout the economic world, and is nowhere more sensitive than in the money markets. Money is cheap when there are plenty of surplus funds and is dear when there is a scarcity of loanable funds.

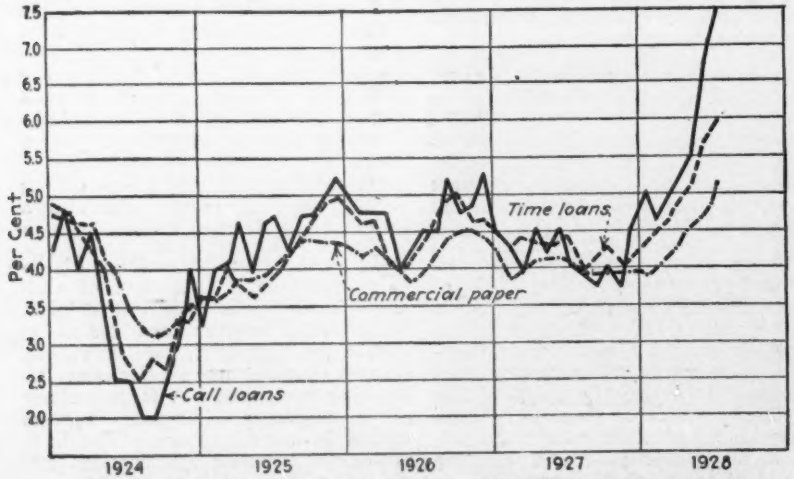
Of the different types of loans, "call money" is subject to the greatest fluctuations, being most sensitive to market changes. Call loans, however, known also as demand loans, may be terminated at any time by action of either party. The borrowing is done by Stock Exchange houses, the loans being secured by Stock Exchange collateral—stocks and bonds. Such security is immediately salable, and such a loan can be readily liquidated. The construction industry is not especially interested in this type of loan, requiring for its purposes loans which extend over a considerable period of time.

### E. N.-R. Index Numbers

| Cost | | Volume | |
|---|---|---|---|
| **Oct. 1, 1928** | **207.71** | **September, 1928** | **286** |
| Sept. 1, 1928 | 207.29 | August, 1928 | 306 |
| Oct. 1, 1927 | 204.40 | September, 1927 | 273 |
| Average, 1927 | 206.24 | Average, 1927 | 263 |
| Average, 1926 | 208.03 | Average, 1926 | 228 |
| 1913..... | 100.00 | 1913..... | 100 |

A second common type of money quotation is "collateral or time loans." These have a definite date of maturity, being subdivided into loans for 60 days, 90 days, four months, etc. Such loans are not eligible for discount. In other words, they are not purchasable by the Federal Reserve banks, ranking with "call loans" in this respect. This is the type of loan of general interest to the construction industry, the quotation being indicative of the prevailing rates for loans extending over a considerable period of time. As such, the quoted rates of this type of money have a distinct influence on construction operations. High money rates, if they persist long enough, are bound to result in the deferment of large construction projects in expectation of cheaper money in the near future. Such a situation is developing at the present time, although the volume of contracts let during September does not indicate any material trend in this direction as yet.

The third type of loan and one in which the construction industry is also interested, especially from the standpoint of the distributor and manufacturer of construction materials, is that dealing with "commercial paper." Commercial paper differs from the collateral or time type of loan in that it refers to notes of merchants and manufacturers. Such concerns in the ordinary business sense sometimes require more money than their banker can loan any one customer. They also wish to keep their bank open to take care of their current requirements. Commercial paper, then, is defined as notes drawn by business houses to finance the purchase of merchandise or to carry merchandise or accounts receivable. They are in turn sold to a commercial dealer and eventually may be sold to a bank with surplus funds, which may desire the particular maturity offered.




INTEREST RATES HAVE ADVANCED MATERIALLY DURING 1928

## Contract Awards 68 Per Cent Over Last Year

The value of contracts awarded for the week ended Oct. 9 totaled $83,237,000, as against $87,345,000 during the week previous and $49,345,000 during the same week last year. Gains were recorded in practically all the various classes of construction, but the large increase over last year was due mainly to the awarding by New York City of a contract for water-supply tunnel at a cost of $42,693,000. If this item is deducted, the current volume of contracts let will be slightly under that of the same week last year. The large total for the week previous was due to the awarding of a large contract by the Savannah River Electric Company for a $20,000,000 hydro-electric project on the Savannah River. Contracts awarded for buildings, both industrial and commercial, continue to exceed the volume reported last year by slight amounts. The only outstanding decrease was reported for streets and roads, the current volume of awards being about 23 per cent under the same week last year.

The accumulated total of contracts awarded for the year is $2,858,298,000, as against $2,484,183,000 during the same period last year, or a gain of 15 per cent. There seems to be no apparent indication of a material drop in the volume of contracts awarded, which some authorities have prophesied for the fall months due to the continued high money rates. There is every indication at the present time that the activities within the general construction industry will continue on a high plane during the remainder of the year.

Such a continuation of high construction activity also reflects an assurance of general good business for the rest of the year. In view, however, of the exceptional activity of business during the past summer it would probably be too much to expect the fall expansion to be as large as usual, and the chances are that business is at or near the peak of activity for the year.

### This Week's Contracts

Heavy construction contracts, reported by *Engineering News-Record* in the week ended Oct. 9, with some comparisons, total as follows:

(In Thousands of Dollars, 000 Omitted)

| | Oct. 9, 1928 | Oct. 2, 1928 | Oct. 11, 1927 |
|---|---|---|---|
| Buildings: | | | |
| Industrial..... | $2,674 | $23,678 | $1,637 |
| Commercial..... | 21,007 | 32,495 | 19,203 |
| Streets and roads.. | 10,329 | 19,001 | 13,029 |
| Other construction. | 49,227 | 12,171 | 15,476 |
| Total..... | $83,237 | $87,345 | $49,345 |
| Total, all classes, Jan. 1 to Oct. 9: | | | |
| 1928..... | | | $2,858,298 |
| 1927..... | | | 2,484,183 |